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VOL. 39 - MAI - JUIN 1960 No. 3

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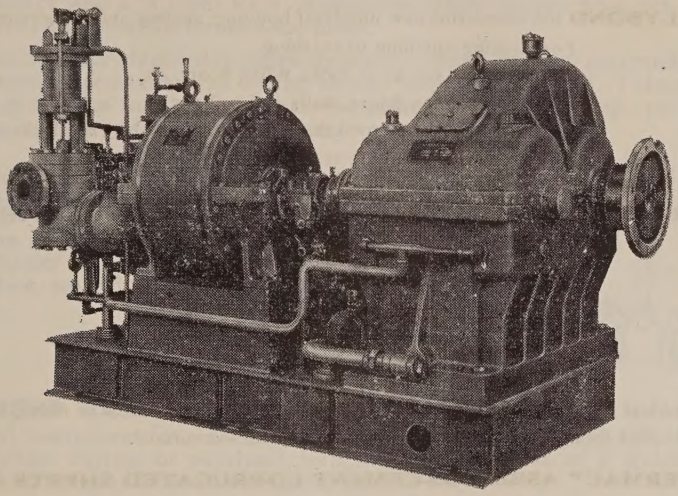

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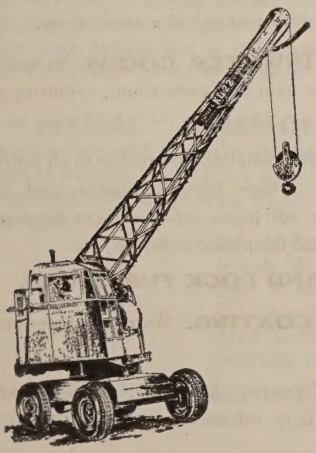

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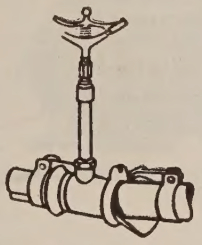

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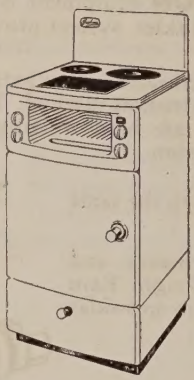

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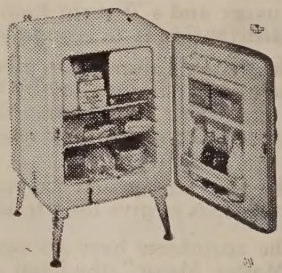

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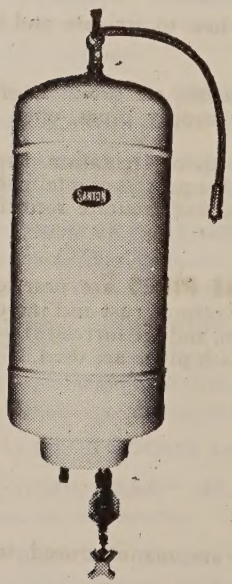

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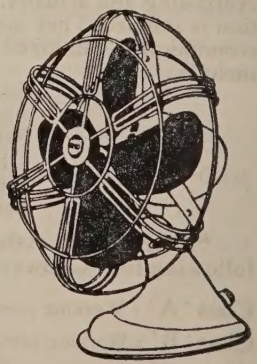

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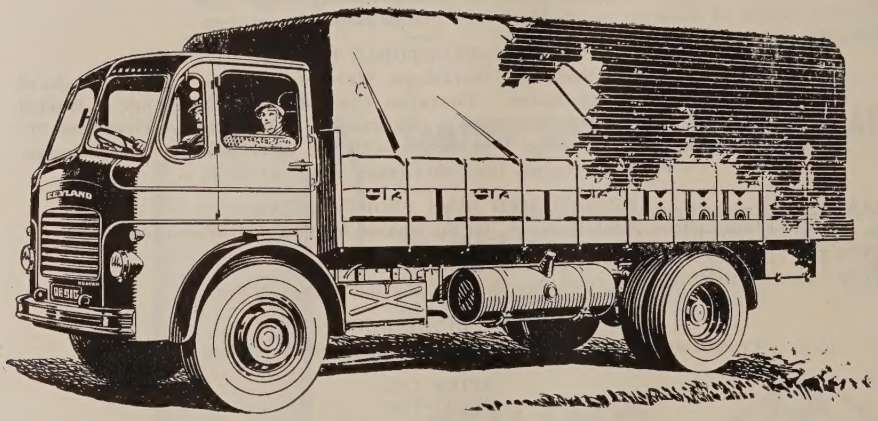

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REVUE AGRICOLE ET SUCRIÈRE DE L'ÎLE MAURICE

VOL. 39 No. 3 MAI - JUIN 1960

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Lorsque les articles sont accompagnés de schémas, ceux-ci doivent être autant que possible du même format que la revue (18 x 25 cm. ou 7 x 10 pouces) ou occuper une page pouvant être pliée dans un sens seulement.

La rédaction accueillera avec reconnaissance des illustrations appropriées au texte de tout article ou mémoire; les photographies devront autant que possible avoir les dimensions suivantes: 9 x 14 cm. ou 3 1/2 x 5 1/2 pouces et être faites sur papier glacé.

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1960

NOTES ET ACTUALITÉS

Le Congrès Sucrier

Ainsi que nous l'avons annoncé dans le dernier numéro de la Revue, le Congrès Sucrier s'est tenu sous l'égide de la Société de Technologie Sucrière et Agricole de l'Ile Maurice du 6 au 11 juin. De nombreux techniciens de notre industrie sucrière y assistèrent ainsi que les représentants des pays voisins. Les travaux du Congrès furent ouverts au Collège d'Agriculture par Monsieur le Major Paul Hein, Président de la Chambre d'Agriculture, en présence de l'Honorable Monsieur S. Boolell, Ministre de l'Agriculture. Monsieur René Noël, Président de la Société de Technologie Sucrière et Agricole accueillit les Membres du Congrès et souhaita la bienvenue aux délégations des pays étrangers qui se composaient comme suit:—

L'Afrique du Sud:	Dr. J. Wilson
	Dr. J. Dick
	Mr. J. Rault
Madagascar:	Monsieur G. Lauffenburger
	,, P. Baudin
Ile de la Réunion:	Monsieur Albert Enoch
	,, Emile Hugot
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	,, André Bénard
	,, Roger Thirel

Voici la nomenclature des communications qui y furent faites et qui donnèrent lieu à d'intéressants débats:

M. E. Davy	An examination of the probability of cyclone damage in Mauritius.
G. Rouillard	Les dommages causés aux plantations de cannes par les cyclones Alix et Carol.
R. Sentenac	Recherche d'eau par prospection électrique dans la plaine septentrionale de l'Ile Maurice.
G. Mazery	Transport et chargement de cannes.
G. Lauffenburger	La lutte contre la maladie de Fidji de la canne à sucre à Madagascar.
P. Baudin	Observations sur les nouvelles galles foliaires de la canne à sucre à Madagascar.
D. d'Emmerez de Charmoy	Un aspect imprévu de la gommose à la Réunion.
R. Noël	Le Bilan thermique idéal en fabrication de sucre roux.
R. Desmarais	Interconnection to Central Electricity Board 22 KV network of selected sugar factories.
P. Hoareau	L'influence de l'efficience de filtration sur la clarification.
A. Duval	How to get the most out of every day electric arc welding.
E. Rochecouste	Future trends in the chemical weeding of cane fields in Mauritius.
B. Sigwalt	La lutte insecticide contre *Perkinsiella saccharicida* vecteur de la maladie du Fidji.
M. Rivière	Imbibition rationnelle et alimentation dynamique des moulins.
J. Dumée Duval	Quelques propos pschycologiques et pratiques sur l'automatisme.
F. Adam	Automation and some aspects of its application to boilers in the sugar industry.
M. Paturau	Bagasse furnaces.
R. de Froberville & J. Dupont	Consommation de puissance des coupe-cannes et des shredders menés par moteurs électriques.
R. Antoine	The thermotherapy of sugar cane plants infested with chlorotic streak disease.
E. F. George	Factors affecting the initiation of flowering in sugarcane.

Le prochain numéro de la *Revue Agricole* sera consacré à la publication des travaux du Congrès.

Nouvelles Variétés de Cannes

Sur l'avis du Comité d'homologation des variétés de cannes, le Gouvernement par proclamation en date du 17 Juin 1960 a homologué les deux nouvelles variétés mauriciennes suivantes : M 202/45 et M 93/48. De par la proclamation citée plus haut ces deux nouvelles variétés peuvent être maintenant cultivées industriellement à l'Ile Maurice. Une troisième variété encore retenue en observation, la M 253/48, pourrait être cultivée dans les climats chauds et humides ou en terrains irrigués de l'Ile aux fins d'essai en grande culture. Ces trois variétés semblent pleines de promesses. La M 202/46 pourrait s'acclimater à presque toutes les régions de l'Ile tandis que la M 93/48 serait plus appropriée aux régions froides et humides des hauts plateaux.

Le Service Vétérinaire Gouvernemental

La Division d'élevage du service de l'Agriculture a tout dernièrement été l'objet d'une réorganisation. La Section d'élevage proprement dite a été transférée à la Division Agricole qui aura maintenant la charge de la Laiterie de Curepipe et du Centre d'Elevage de Palmar. La Division Vétérinaire aura elle charge de la partie ayant plus trait à la Médecine Vétérinaire, aux services d'insémination artificielle et de vulgarisation vétérinaire.

Le service officiel de contrôle des importations d'animaux, de quarantaine et des abattoirs se fera par la Division Vétérinaire relevant directement du Ministère de l'Agriculture. L'Administration de ce service ainsi centralisée au Ministère de l'Agriculture à Port Louis sera d'accès plus facile au public.

La Lutte Biologique Contre L'Oryctes Rhinoceros

La Commission du Pacifique Sud vient de publier un très intéressant ouvrage du Dr Paul Surany sur les maladies et les moyens de lutte biologique des différentes espèces d'oryctes. Cette étude sera utile à tous ceux s'intéressant à la culture du cocotier de même qu'aux techniciens de l'industrie sucrière car il y est aussi fait mention des maladies pouvant affecter le Phytalus.

En ce moment *l'Oryctes rhinoceros* cause d'importants dégâts dans notre dépendance de Diégo Garcia et l'auteur affirme que sans la maladie s'attaquant aux larves de cet insecte les cocoteraies de l'Ile seraient entièrement décimées. Cette publication illustrée de très belles planches marque une étape importante dans l'étude des maladies des coléoptères.

Un Peu d'Entomologie Appliquée

Le moyen de lutte le plus courant contre les insectes s'attaquant aux cultures est l'emploi des insecticides, mais leur usage immodéré peut être plus nuisible qu'utile, leur action, en effet, ne s'arrête pas aux seuls insectes que l'on veut détruire, mais agit aussi sur les parasites et sur les prédateurs pouvant provoquer ainsi des bouleversements souvent graves de l'équilibre naturel. Un exemple de cette rupture d'équilibre est l'influence que les cyclones de janvier et

février ont exercé sur notre faune entomologique. Après ces cyclones des insectes phytophages généralement peu importants sont devenus nocifs par leur abondance soudaine causée par la destruction des hyperparasites et des oiseaux qui les maintenaient en échec.

Devant cet état de choses, il est devenu nécessaire de lutter par des moyens chimiques contre l'incidence accrue de ces pestes. Sur le flamboyant, une chenille de lépidoptère le *Cryptophlebia peltastica* est apparue en si grand nombre dans les nombreuses localités de l'île qu'il a fallu avoir recours à un puissant insecticide systémique : le Phosdrin pour lutter contre elle. Deux épandages du produit en ultra-pulvérisation, au dosage de 60 c.c. du produit émulsionable à 25% pour 10 litres d'eau ont pu enrayer complètement les attaques de cette peste. Sur certains palmiers, l'abondance d'un petit coléoptère chrysomelide : le *Bronstipa limbata* s'est montrée si grande que la pulvérisation des jeunes feuilles au dieldrin ou au DDT a été nécessaire pour protéger ces arbres. Dans certaines cocoteraies de l'Ile, la disparition de la coccinelle : *Chilocorus nigritus* a fait réapparaître un vieil ennemi : l'*Aspidiotus destructor*, ou cochenille du cocotier. Sur les agrumes, les chenilles du *Papilio demodocus* sont en si grand nombre qu'il faut recourir aux épandages à l'arseniate de plomb au dosage de 2 gm/litre. Signalons encore, que sur les troncs d'arbres abattus, on trouve de nombreux coléoptères scolytides qui s'attaquent aussi à nos arbres fruitiers et à nos arbres de forêt et qui, malgré, leur petite taille, causent parfois de terribles ravages. Dans les vergers les dégâts sur les manguiers, parfois centenaires, sont considérables ; dans nos forêts également, en soulevant par example l'écorce des eucalyptus et des tambalacoques abattus, on trouve souvent de nombreuses galeries ramifiées du *Xyleborus testaceous* et du *Xyleborus semigranosus*.

Un autre scolytide le *Xyleborus mornatti* perce de nombreux petits trous, dans l'écorce de l'avocatier, dans chacun desquels les femelles déposent un œuf. Les nombreuses galeries causées par les larves de ces insectes causent souvent des dégâts considérables. Le lindane employé en épandage à 2% est un excellent moyen de lutte contre eux.

Nos plantes maraîchères, comme le choux et le petsaï, sont en ce moment fortement attaquées par les chenilles de *Crocidolomia binotalis* et par des pucerons ; des essais avec le phosdrin se sont révelés efficaces dans ces cas. mais en raison de la toxicité du produit concentré, seul le Service de l'Agriculture est autorisé à l'employer. Sur les jeunes feuilles de piment et de petit pois, on trouve une petite espèce de thrips contre laquelle le dibrom 8 (ou dimethyl dibromo dichloroethyl phosphate) en pulvérisation est d'une remarquable efficacité. Ce produit a l'avantage de ne pas être phytotoxique et de posséder une faible rémanance.

Contre les araignées rouges, le Tedion V 18 (ou tetrachloradiphenyl sulphone) est un acaricide d'une efficacité remarquable. Bien que n'étant pas systémique, ce produit peut pénétrer la feuille et tuer les larves d'acariens sur la surface non traitée. La rémanance est telle qu'à Maurice on a observé un contrôle durant jusqu'à 2½ mois sur les plants d'aubergines et 4 à 5 mois sur les orangers.

L'action ovicide du produit est suffisamment grande pour tuer les œufs même à l'intérieur des femelles. Faisons remarquer que le Tedion n'a aucune action délétère sur les staphylinides prédatrices des araignées rouges et n'est pas toxique à l'homme ou aux abeilles.

Le Service de l'Agriculture procède en ce moment à des essais avec le Thimet, insecticide systemique à grande rémanance qui est appliqué dans le sol avec les semences. Les essais se poursuivent actuellement sur la pomme de terre et si les résultats obtenus en Amerique se confirment ici, on pourrait s'attendre à ce que l'Ile Maurice puisse produire bientôt ses propres semences ; Le Thimet pouvant influencer l'incidence des maladies à virus en exerçant un contrôle sur les vecteurs de ces maladies.

Ce produit pourrait peut être encore servir au contrôle du Perkinsiella, le vecteur de la maladie de Fidji, dans les pays où ce mal est d'importance économique.

Autres Pesticides

On trouve sur le marché en ce moment des crêmes antilimaces ainsi que des appâts granulés au méta. Cela facilite la lutte contre les escargots et les achatines dans nos jardins.

Signalons également deux raticides nouveaux le Tomorin et le K.B.-rats, qui sont des appâts raticides. Le Tomorin contient 1 pour cent de coumachlore. Le K.B.-rat est présenté sous forme de petits blocs, prêts à l'emploi, enveloppés dans du papier paraffiné.

Pour les horticulteurs il nous faut également faire mention d'un fongicide — insecticides en aérosol qui tue les pucerons du rosier tout en empêchant l'apparition de taches noires des feuilles causées par le champignon *Actinonema rosæ*.

Les petits éleveurs eux aussi, n'auront plus à craindre la présence de poux et d'acariens sur leurs volatiles, grâce à un produit contenant 3% de Malathion et qui s'emploie aussi sous forme d'aérosol.

THE CYCLONE SEASON 1959-60

by

E. G. DAVY

Only eight tropical depressions formed last summer compared with the normal of about twelve. Although only half of these attained any great intensity, three seriously affected land masses. Tromelin Island suffered badly for the second season in succession. In Mauritius a very long period of 14 years (since February 1946) of virtually complete freedom from cyclones was ended by two very severe storms in January and February. Tracks of all depressions and their intensity are shown on the diagram on opposite page.

From the beginning of the year, it was decided to give girls' names to all tropical cyclones of which the intensity justified warnings to ships. Only five names were used, three of the season's depressions having existed in the last quarter of the year 1959.

The first depression of the season, existing in the first days of November, was of small diameter. After passing westwards, north of Diego Suarez, it curved sharply south-east across northern Madagascar but was weak and of relatively little importance. Depression " DIANE " crossed southern Madagascar from the Mozambique Channel before its intensity became moderate in the Indian Ocean well south-west of Réunion and well away from any land.

Three other depressions were also of little importance because they were weak, short lived or far from land and ships, they were the depressions very far to the north-east during late November : " BRIGITTE " on the 29th January and " ELISE " during early April. The last of these was of very complex structure.

The remaining three cyclones of the season were however all intense and of much importance. On the 26th December, an observation from a Japanese ship indicated the existence of a quite intense but small depression well south-east of Diego Garcia. Moving approximately west, it passed about 100 miles north of St. Brandon on the 30th and, then curving southwards, it passed a few miles south-east of Tromelin Island on the 31st. This isolated meteorological station reported a minimum pressure of 969 millibars ; the anemometer was blown down before the worst of the storm, but gusts estimated to have been amongst the strongest known in this area put the station out of action for over 24 hours. Leaving Tromelin, the cyclone moved approximately south, passed about 200 miles west of Réunion on the 2nd January and moved out of range of all observations.

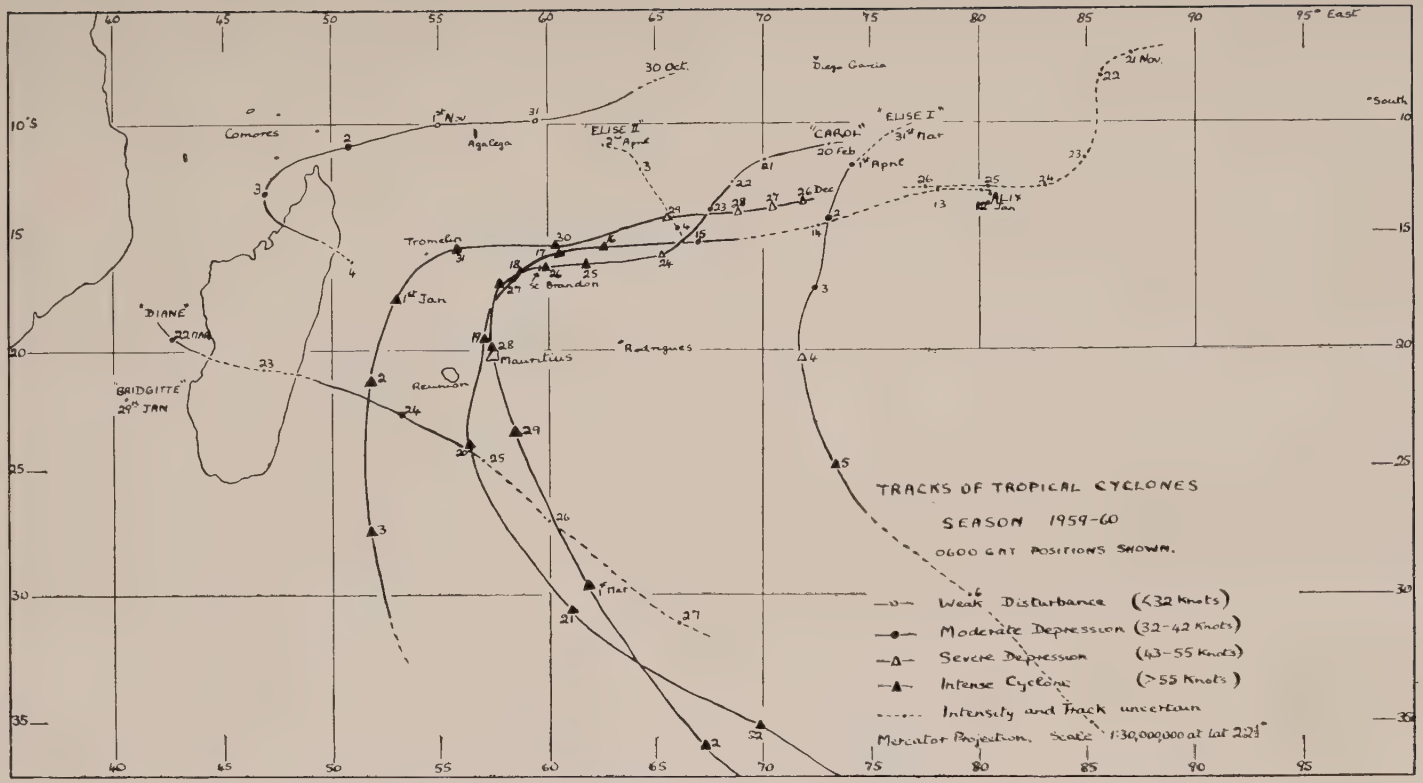

DIAGRAM SHOWING TRACKS OF DEPRESSIONS AND THEIR INTENSITY — CYCLONE SEASON 1959-60

The first cyclone of 1960, named "ALIX", gave Mauritius a very grave reminder that the island is in the normal area of tropical cyclones and that only by chance has it escaped serious damage since the bad cyclones of 1945. "ALIX" was tracked on the weather charts from the 12th to the 23rd January and passed about 20 miles west of Mauritius on the 19th. On the 12th, an active depression existed about 1,300 miles to the east-north-east of Mauritius and conditions were unsettled south of Agalega. During the next three days the activity south of Agalega increased then became absorbed into the circulation of the deeper depression which had moved westwards to within 600 miles of Mauritius.

When about 400 miles north-east of Mauritius on the 16th February, the movement of "ALIX" decreased and became increasingly nearer to south-west so that the centre passed about 20 miles north-west of St. Brandon on the 17th. Subsequent movement towards approximately south brought "ALIX" within 20 miles of the west coast of Mauritius during the afternoon of the 19th. Moving rapidly away south then south-east, the storm lost its violent tropical characteristics over the colder seas about 1,500 miles south-east of the Mascareignes by the 23rd February.

The last tropical depression of any importance was "CAROL" — probably the most intense cyclone ever recorded in the south-west Indian Ocean and certainly the most severe registered in Mauritius during a long period of records extending back well over a century. On the 20th February, about 250 miles south of Diego Garcia, a weak tropical circulation formed in a pre-existing area of low pressure. During the next three days this tropical depression remained of weak intensity and moved rather slowly south-west, but by the 24th February, it had become quite severe and its track showed an "inverted curve" towards west. With continued intensification, the centre moved steadily westwards towards St. Brandon and passed directly over that island on the 26th giving the lowest pressure of 942 millibars, winds estimated up to 160 m.p.h. in gusts, and a central calm lasting four hours. Identical conditions were registered over Mauritius during the 28th February after the track had turned south bringing this large and intense storm directly over the whole of this island. Although it is intended to publish a full account of the winds, pressure and rainfall of both cyclones "ALIX" and "CAROL", the salient facts should be given here.

At St. Brandon, cyclone "ALIX", 20 miles to the north west on the 17th January, gave a lowest pressure of 975 millibars (731 mms) and gusts estimated at 123 m.p.h., as the wind backed steadily from south-east to north. Considerable damage was caused, and the raingauge was unusable because of flooding from the very high seas. Mauritius experienced similar conditions as the cyclone passed about 20 miles away off the west coast during the afternoon of the 19th. Barometric pressure

fell to 970 millibars (727 mms.). Wind speed over a whole hour probably reached 60 m.p.h. and gusts 100 to 125 m.p.h. over all districts except the flat plains of the north and east where figures of 50 m.p.h and 85 to 100 m.p.h. apply. Wind direction backed about 120° from east to north-north-west in the 20 hours of gale winds. Wider ranges of speed and more violent changes of wind direction certainly occured in some localities such as Montagne Ory and St. Pierre near mountain ranges. At Réunion Island the highest gusts did not reach 90 m.p.h. Rainfall in 48 hours varied from 8" in the west and north of Mauritius to 30" on the western part of the plateau.

For fourteen years in Mauritius numerous buildings, installations and trees had had no hurricane winds to test their increasing weaknesses so that "ALIX", among the ten most severe cyclones which the island had suffered in 85 years, found much on which to satisfy her fury. Havoc was wrought in the forests, 11,000 homes were destroyed and a further 9,000 were damaged beyond permanent repair. Six persons were killed and 25,000 sheltered in refugee centres, all roads were blocked and telephone and electricity services badly damaged. The sugar crop which had been in an outstandingly promising condition at mid-January, was about 20% destroyed. But worse was to come only six weeks later.

As will be concluded from the comparative table on opposite page cyclone "CAROL" was certainly the most intense recorded in Mauritius in the last 88 years. "CAROL" was almost certainly the worst that has buffetted Mauritius since man has lived here, for the next most intense, the historical cyclone of 1892, was officially described as "unprecedented".

Perhaps the newer instruments are more sensitive to gusts but a reliable comparision is provided by wind speeds over a whole hour and by barometric pressure, both of which have reached figures unknown in Mauritius until this year. The highest accurately measured wind speed over an hour reached a record of 83 m.p.h. with gusts to 159 m.p.h. and the lowest pressure was 943 millibars (707 mms.). Rainfall in 48 hours was, as in "ALIX", about 8" in costal districts but reached only 24" on high-ground.

If any confirmation of the extraordinary violence of "CAROL" is needed, it will be found in the damage caused. The sugar crop has apparently been reduced to a half of the figure it should normally have attained, the forests and fruit trees can never have presented so sad a spectacle, vegetable crops were completely obliterated. Buildings destroyed numbered 70,000 (compared with 10,000 in 1945) and many thousands more were damaged beyond permanent repair. Prepared centres housed 80,000 refugees, ten times the number of those who sought shelter in January 1945, and nearly twice the estimated number of homeless in April, 1892,

Comparative table of wind speeds and barometric pressures

	Highest Gust m.p.h.		Highest mean over a whole hour m.p.h.		Lowest barometric pressure correct M. S. L.	
Cyclone "Carol" 28th February, 1960	South-East	West-North-West	South-East	West-North-West	Millibars	Millimetres
Medine (West) ...	159	111	83	60	—	—
Port-Louis (North West) ...	(160)	(150)	(105)	(100)	942.6	707
Pamplemousses (North) ...	148	109	82	60	—	—
Union Flacq (East) ...	148	107	78	70	—	—
Plaisance (South East) ...	(130)	115	74	69	945.3	709
Vacoas (West Centre) ...	118	114	55	48	(945)	(709)
Cyclone "Alix" 19th January 1960	East	North-East	East	North-East	Millibars	Millimetres
Pamplemousses ...	85	80	48	45	969.7	727
16th January, 1945	East	North-West	East	North-West		
Pamplemousses ...	90	84	63	50	953	715
Vacoas ...	89	98	59	55	—	—
Plaisance ...	97	93	66	—	—	—
1st/2nd February, 1945	South-West	North-West	South-West	North-West		
Pamplemousses ...	74	72	49	—	981	736
Vacoas ...	84	89	54	49	(979)	(734)
Plaisance ...	93	80	69	50	969	727
29th April, 1892	North-East	South-West	North-East	South-West		
Pamplemousses ...	(108)	(134)	60	76	947	710

Comparative table of duration of strong winds meaned over a whole hour, in miles per hour, at Pamplemousses

	Over 40	Over 50	Over 60	Over 70	Over 80	90-99
28th February, 1960	11	7	3	2	1	0
19th January, 1960	13	0	0	0	0	0
16th January, 1945	16	5	0	0	0	0
29th April, 1892	7	3	2	1	0	0

Figures in parenthesis have been estimated from other data.
Figures not in parenthesis were measured on reliable instruments.

A more pleasing and surprising figure is that of only forty persons killed in spite of the greatly increased population and the enormous devastation to buildings and trees. In the 1892 cyclone there were 1,100 deaths. A number of causes probably contributed to the comparatively low death rate on the 28th February, 1960. The worst of the wind and damage occurred in daylight so that persons could move more easily and could avoid danger from falling debris. The very long period of four hours bright calm weather as the "centre" passed permitted persons in threatened situations to move to relatively secure buildings and many tottering buildings and weak roofs and openings were secured during the symphony of hammering which sounded throughout Mauritius during the lull in the middle of that awful day.

But any reasoning about the low death rate, or in fact about many aspects of the damage, would be incomplete without mention of pre-planning and warning for the disaster. Cyclone "ALIX" had given all services a dress-rehearsal for the real drama of "CAROL". The public had been seriously reminded of the nature of cyclones only six weeks earlier, and the warnings given by the Meteorological Service over the long period of 74 hours before the centre passed were well heeded. Precautionary measures taken were as complete as they have ever been and apparently resulted in the saving of much property and many lives.

The cyclone season of 1960 is likely to replace, and one hopes for very many years, the previously infamous 1892 as being the year of the great cyclone.

LA MÉLANOSE DE LA MANGUE

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En février 1958, nous fûmes invité à visiter le verger d'une propriété sucrière du Nord où l'on se plaignit d'une maladie de la mangue dans laquelle la peau noircissait plus ou moins complètement et, surtout pour le cultivateur amateur visant à la beauté et à la perfection de ses produits, faisait perdre au fruit toute sa valeur.

Nous avions déjà observé cette affection, trés commune ici, mais comme les autres caractères du fruit, goût, parfum, etc , n'en sont pas affectés, nous ne lui avions pas donné une grande importance et l'avions négligée pour d'autres maladies réclamant davantage notre attention. A ce que nous sachions, cette maladie n'avait pas encore été décrite sur la mangue et semblerait ne pas l'avoir été jusqu'ici ; comme résultat de l'étude que nous en fîmes alors, nous lui donnâmes le nom de mélanose, qui veut dire une maladie causée par une accumulation de matière noire dans les tissus.

Elle est caractérisée par la formation dans les couches superficielles de l'épicarpe, d'une multitude de minuscules taches rondes et noires, surtout à la partie supérieure du fruit, où elles sont souvent si rapprochées, que la peau y devient d'un noir presque uniforme. De la zone affectée, des traînées formées de taches noires semblables, s'étendent en forme de larmes vers le bas du fruit (phot. 1) et constituent un caractère assez typique de l'affection.

Les tissus superficiels de la peau dans le voisinage plus ou moins immédiat des taches, parfois les tissus des taches elles-mêmes, se fissurent par la formation de fines traînées de liège qui s'anastomosent entre elles dans toutes les directions, formant un réseau dont l'aspect, toutes proportions gardées, rappelle celui d'une couche de boue desséchée, fendillée dans tous les sens (phot. 2).

Le liège formé surélève légèrement les lèvres des fissures, ce qui fait que la peau d'ordinaire lisse du fruit, devient rugueuse, paraissant comme du papier sablé au toucher. Dans la plupart des cas, les mailles du réseau sont de dimensions relativement petites, mesurant de 1 à 2 mm environ de diamètre ; mais parfois, surtout vers le bas des fruits, elles sont de fortes dimensions, mesurant jusqu'à 7 et 8 mm et sont alors séparées entre elles par des plages de liège larges de plusieurs millimètres. Dans ce cas, le liège se développe aussi au-dessous des plaques formant

Phot. 1 — Mangue montrant des coulées de larmes à gauche. La peau est complètement noircie à droite.

Phot. 2 — Partie inférieure d'une mangue au stade dit ' mud-cake '.

le réseau, et les force à se détacher en écailles minces et friables, offrant l'apparence d'avoir été carbonisées.

Une maladie appelée la mélanose, avec des symptômes identiques à ceux rapportés ici, à été décrite sur les agrumes. Tout y est les minuscules taches noires, l'aspect de boue desséchée dit « mud-cake type » et les traînées en forme de larmes (ou « tear-staining »). Comme la mélanose des agrumes est causée par le *Phomopsis citri*, dont le stade parfait est un *Diaporthe*, nous avons donc recherché ce champignon dans les tissus affectés des mangues.

Nos efforts restèrent quelque temps vains, mais certaines préparations du type « mud-cake » ayant montré occasionnellement au microscope de rares spores de *Phomopsis*, nous recherchâmes les pycnides du champignon sur les tiges mortes se trouvant sur les manguiers. Les coulées de larmes proviendraient de spores transportées des pycnides par des pluies légères ou par de fortes rosées.

Nous réussîmes finalement à trouver sur un manguier portant des fruits malades à Rose Hill, quelques tiges mortes couvertes de petites pustules constituant les pycnides d'un *Phomopsis*. Vu donc, d'une part, la concordance des symptômes sur les agrumes et sur les mangues et d'autre part, l'existence d'un *Phomopsis* sur les manguiers, comme c'est le cas pour les plantes du genre Citrus, nous nous considérions à ce stade autorisé à assumer que la maladie décrite ici était causée par le *Phomopsis* trouvé.

Le 21 mars 1958, nous écrivîmes au Directeur du *Commonwealth Mycological Institute* à Kew lui faisant part de nos observations et lui envoyant en même temps quelques spécimens de tiges malades. Dans sa réponse en date du 2 avril suivant, nous fûmes informé que l'examen des spécimens avaient révélé la présence d'un *Phomopsis* semblant bien être le stade conidial du *Diaporthe citri* (Fawc.) Wolf, en même temps que d'un autre champignon, le *Diplodia natalensis* Evans. Notre attention fut aussi attirée sur le fait que ces deux champignons avaient été trouvés associés à une pourriture de la mangue (stem end rot) en Floride. On considère, cependant, que cette pourriture serait plutôt causée par *Diplodia natalensis* (1, 2).

Comme nous avons pris notre retraite à la fin de janvier de cette même année, nous n'avons pu rechercher comment contrôler la mélanose de la mangue. Nous pensons cependant que des applications de fongicides cupriques ou de composés sulfureux organiques comme les dithiocarbamates et leurs dérivés métalliques — le zineb par exemple — ou encore de ces préparations mixtes de produits cupriques et de dithiocarbamates, comme le Blitane, pourraient, avec des appareils puissants, donner de bons résultats.

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THE PRODUCTION OF FOODCROPS IN MAURITIUS

by

G. A. NORTH COOMBES & A. D'EMMEREZ DE CHARMOY

Mauritius lies in a region of cyclones. It is essentially sub-tropical with a maritime climate rather than tropical, except on the coast for the three hot and wet months of the year. The first part of the summer, from September to December is dry, a time when irrigation supply is necessarily limited and in certain years not available. The hot wet summer months of January to March when cyclone incidence is the greatest are followed by a generally wet April and a winter often characterized even at the lower altitudes and on the coast by drizzle or heavy morning dew. In short, Mauritius is not well adapted climatically for the production of major annual food crops like rice and maize.

Although only a tiny island, Mauritius is not characterized by a single type of climate, agriculturally speaking. The climate changes from the semi-arid on the coastal areas of the north-eastern, northern and western parts to conditions more akin to the wet tropics further inland. The seasonal changes may be summarized briefly, as follows :—

Lowlands

(i) Hot rainy season, December to mid April ;

(ii) Cool dry season with occasional showers, mid-April to mid-December.

Uplands

(i) Warm rainy season, mid-December to April ;

(ii) Cool damp period with Orographic rains, May to September ;

(iii) Dry season, mid-September to mid-December.

Whether or not one or many cyclones visit the vicinity of Mauritius in any year, the fact remains that the summer rains, in frequency and intensity are largely dependent upon cyclonic disturbances occurring within influencing distances of the island. There is never any certainty of steady rain. In consequence, an annual food crop like maize will have to be resown if destroyed early in the hot season, and there may not be rain for a fortnight or more so that replanting is in fact impossible while at the same time the warm season gets shorter and a satisfactory yield can no longer be obtained.

With the above consideration in mind, a review of food crop production in Mauritius over the last fifty years or so may now be attempted in broad outline.

The starting point coincides with the scarcity of food during the First World War. Attention was then given to the production of maize in substitution of as much as possible of the imported rice and flour. Attempts were also made to foster the development of rice growing in the Island's efforts to

produce its food. It is perhaps best to consider these efforts under these two crops which at the time received some encouragement.

Maize

Maize does very well in Mauritius and although it yields most when planted in summer, it can go in at other times in places where conditions are not too dry. Under irrigation it can be grown throughout the year. In the course of both world wars it was planted on a large scale but, as may be expected under such conditions, with not the best results. At both periods, as soon as the population could get regular supplies of rice, maize ceased to form part of its diet, being then grown only on a small scale for consumption tender or for poultry.

A major difficulty had of course been how to ensure the satisfactory drying of the maize at producer's level. To get over this, Government in 1917 erected a maize drying plant at Grand Port which was then the most important centre of production. This plant was operated on a commercial basis. It functioned for a few years but when more normal conditions returned and the price of imported maize fell below that of locally grown maize, the drying establish ment was sold.

Up to a few years ago the maize grower enjoyed a certain amount of protection from competition by foreign maize, the import duty being Rs 4. per hundred kilos, i.e. Rs 40. per ton. In spite of this heavy duty, however, foreign maize was on sale on the local market even when, owing to unfavourable conditions such as for instance the drought of 1938-39, local production fell very low and the price of local maize rose as a result. Since 1954 the import duty has been lowered to Rs 10. per ton.

Rice

Rice has, at times, been cultivated in Mauritius in small quantities. From such cultivation a type of rice which came to be known as " Creole " rice, was selected and cultivated in the southern coastal parts for its intrinsic qualities of flavour. This rice was so good that it could find a market at 4 to 5 times the value of imported Indian rice. It was cultivated mostly on the hills of Grand Port by the Creole section of the population. Curiously enough, the people responsible for this disappearance were the rice consumers themselves, namely the thriftier Indo-Mauritians who bought the land used for such cultivation and promptly put it under sugarcane.

The Department of Agriculture has at various times made energetic efforts to promote rice growing particularly about 1918 when the food supply was very scarce. In 1919 there were about 70 acres of unirrigated rice. The rice question then appeared to have fallen into oblivion until 1929, when 4 new experimental areas were established. For various reasons, including the floods of December 1929, the attempts failed. In that year the area under rice was estimated at 30 acres. It seems to have increased to about 300 acres in 1932, largely owing to the re-erection by private enterprise of a disused rice mill. The

mill closed down in 1933 and no more rice was cultivated. In 1938, it was decided to renew experiments with rice on a more ambitious scale. The rainy season however turned out to be one of the worst on record and nullified the results. There were then 19 acres under rice in the whole island. In the opinion of many people, including small Indian planters, rice yields poorly in Mauritius and cultivation is attended by serious risks, the most important of which are cyclones and depredation by birds. There is also a severe leaf spot and drizzle at time of harvest. It thus seems hardly possible for Mauritius to grow rice cheaply enough to compete with imported rice.

In properly costed experiments with rice carried out in 1938-39, the yields of paddy varied from 22 to 660 kgs per acre under non-irrigated conditions. In naturally wet conditions, a yield of about 1 ton of paddy was obtained per acre. Under irrigated conditions, in the blackish soils of Black River, the highest yield was 2,208 kgs of paddy per acre. Cost of production varied from Rs 0.15 per kg under irrigation to Rs 1.17. At present day values, these costs would be Rs 0.49 and Rs 3.86 per kg of paddy respectively.

Mauritius, whether it liked it or not, had to plant food crops with a view to self-sufficiency halfway through the Second World War. The scheme provided for the yearly production of 28,000 tons of maize, 28,000 tons of manioc, and 56,000 tons of sweet potato per annum in replacement of the pre-war consumption of 56,000 tons of rice imported from Burma and India. The large anticipated production of maize made it necessary to erect and equip a new maize mill of adequate capacity. This was constructed at Richelieu and began operations in May 1943. It had a capacity of 3 tons of *maize rice* per hr. This large scale production was limited to estates and planters cultivating 20 arpents and upwards. Small planters because of difficulty of implementation and enforcement were left out of the scheme but were encouraged by an active propaganda campaign to plant voluntarily such food crops as they could undertake. Results were extremely disappointing.

The first results of this large scale experiment which, incidentally, was carried out on the best sugar lands of the island, were extremely unsatisfactory. Drought had caused a 40% reduction in the estimated yield of the maize crop ; sweet potatoes were also affected. The crops initially affected by drought came under the influence of a comparatively mild but late cyclone which did much damage to the maize crop. These poor results and the dire necessity to produce food at any cost, induced the authorities to increase the area under food crops while at the same time reducing the target figures of production for

maize from 28,000 to 20,000 tons,

manioc from 28,000 to 20,000 tons,

sweet potatoes from 56,000 to 12,000 tons,

the new programme aiming at a production equivalent in terms of rice to 33,000 tons.

By the end of 1943, the results of this large scale cultivation were available. They were so disappointing that the Home Government sent the Food Adviser to the Colonial Office to see for himself and make recommendations. He found the position precarious and advised a revision of the whole planting programme with a view to giving it greater flexibility, but only small adjustments could be made as the substitution of maize by other cereals was not feasible on a large scale.

A greatly reduced planting programme was planned for the third year of the country's efforts to raise its own food, the programme aiming at the production of :—

12400 tons maize,
14850 tons manioc,
3400 tons sweet potatoes,
3000 tons arouille and peanuts

giving in terms of rice a total of 19,400 tons as compared with a target of 33,000 tons in 1943-44 and 56,000 tons in 1942-43. The actual production for the period 1st January to 30th September, 1944, however, was only :—

5,484 tons of maize,
4,700 tons of manioc (estimated)
2,300 tons of sweet potato (estimated)

In consequence of this further failure and the substantial loss which the sugar industry had thereby suffered, the increasing deterioration of the best arable land, the growing inadequacy of the labour supply, the increasing cost of production, coupled with the fact that only one cargo of 10,000 tons of flour would balance the anticipated annual local production of cereal substitutes, the Food Production Scheme was abandoned in February 1945. From the agricultural point of view, the attempt at large scale food production was a fiasco Whether or not the scheme had its justification in the amount of food released for consumption elsewhere and the saving in ship's space in war time is of course, another matter.

The return to normal conditions of food supplies after the war took several years. The enforcement of compulsory planting of food crops and the bad results obtained had developed a complex in the minds of local farmers, large and small, towards food crop cultivation. This, combined with the neccessity to replant cane over an area of 33,000 acres, was not conducive to further growing of foodcrops. However, imported supplies being still scarce, it was imperative to induce planters to produce more food. In consequence, a Food Production Board was instituted in 1947 with the object of :—

i) Organizing and encouraging the immediate increase in local foodstuff production to meet the more urgent needs of the population ;
ii) Framing a long-term policy with the object of developing food production as a normal part of the island's farming activities.

To attain its first objective, the Board recommended a scheme of subsidisation of certain food crops. This was approved in June 1947 and implemented at once. Subsidies guaranteed on an acre basis were as follows :—

Maize — Rs 30. per arpent cultivated + Rs 25. per ton of shelled maize delivered at the Maize Mill ;

Manioc — Rs 50. per arpent cultivated ;

Eddoes (arouilles) — Rs 50. per arpent cultivated ;

Sweet potatoes — Rs 40. per arpent cultivated ;

Arrowroot — Rs 50. per arpent cultivated ;

Groundnuts — Rs 30. per arpent with a guaranteed minimum price of Rs 550 per ton of unshelled nuts at 12% moisture content.

This Scheme aimed at subsidising principally crops of relatively low market value which are within easy cultivation possibilities of the mass of the farming community. No subsidy was granted for crops like rice, potato, pulses and others of relatively high market value already bringing in handsome returns. The scheme with modifications remained in force until 30th June, 1949, with results given in Table I.

TABLE I

Area in Arpents of Foodcrops Harvested

	Maize	*Manioc*	*Eddoes*	*S/Potatoes*	*G/Nuts*	*Potatoes*	*Rice*	*Total*
1946-47	2,973	507	160	180	356	—	—	4,176
1947-48	10,000	1,600	425	625	2,200	800	1,875	17,525
1948-49	9,862	2,405	587	621	2,006	955	856	17,292
1949-50	8,078	1,382	420	215	1,291	1,120	649	13,155
1950-51	4,874	862	316	301	1,170	977	379	8,879
1951-52	4,429	865	353	413	1,654	1,181	71	8,966
1952-53	4,244	752	308	409	1,188	1,366	66	8,333
CALENDAR YEARS								
1954	—	—	—	—	—	—	—	8,191
1955	3,345	504	108	259	546	785	37	5,584
1956	2,405	272	168	191	394	933	—	4,363
1957	1,597	305	183	345	1,052	571	—	4,053
1958	883	72	85	340	371	1,043	—	2,794
1959	908	86	99	218	289	1,117	—	2,717

These figures show a remarkable increase in production from 1946-47 to 1947-48. In the subsidised crops, a decline started immediately after the withdrawal of the subsidies after 1948-49. This downward trend in the area cultivated has continued until the present time. The first of the two marked falls in the period 1947-48 to 1952-53 resulted from the withdrawal of the subsidy scheme in June 1949 ; the second from the removal of the guaranteed price for maize.

From 1950-51 to 1952-53, the acreage under various food crops remained relatively constant. This was due to the fact that a "Mechanical Unit" had been set up by the Food Production Board. This unit started operating in April 1951. It undertook work for farmers on the condition that any new area cleared must first be planted to food crops for a period of at least one year before the land could be put under sugarcane.

After 1954 the drop in the acreage of food crops is sharper. This was mainly due to imported supplies being more freely available and to the general inclination of farmers to cultivate as much sugar cane as possible. A further drop in the acreage under maize in 1958 and 1959 resulted from the unrestricted introduction of maize from South Africa combined with a general increase in cost of producing the crop locally largely through the higher cost of labour.

Table II gives a more complete picture of the acreage at present under food crop cultivation in that vegetables not previously recorded are included.

TABLE II

Year	*Maize*	*Manioc*	*Eddoes*	*S/Potato*	*G/Nuts*	*Potatoes*	*Peas & Beans*	*Pineapple*	*Brinjals*
1958	883	72	85	340	371	1,043	1,027	63	372
1959	908	86	99	218	289	1,117	1,163	135	716

Year	*Tomatoes*	*Ginger*	*Creepers*	*Mixed Vegetables*	*Total*
1958	1,855	60	678	2,246	9,095
1959	2,321	97	753	1,875	9,777

The general attitude of the Mauritian farmer to food production may be briefly stated as follows :—

i) Sugar estates and the bigger cane planters do not normally grow food crops. Only a few of them do that, on a small scale, often raising the crops on their thrown-out land and in the inter-rows of cane.

ii) Small planters (up to 10 acres in area) are virtually the only steady producers of food crops and vegetables. They cultivate the food crops in regular rotation with sugar cane always taking an inter-row crop whenever possible even occasionally between the lines of freshly cut ratoons.

The following factors contribute to the attitude of estates and large planters to the cultivation of food crops :—

i) *Labour Shortage* — Food crops generally require more labour than cane and if their raising coincides, as it does at certain times of the year, with high requirements by the sugar grower, then there is a tendency either to neglect food crops or not to grow them at all.

ii) *Herbicides* — The use of weed killers is now a regular feature of estate practice. Herbicides constitute a danger to food crops. Co-operation will be necessary to ensure maximum food crop production either in pure stand or between cane rows in fields lying within harmful distance of weed killers.

iii) *Praedial Larceny* — This, unfortunately, is practised on a large scale in Mauritius and has resulted in many growers abandoning in despair the production of fruit, vegetables and food crops. Praedial larceny takes place even while the crop is still immature.

iv) *Control of Erosion* — Land under the majority of food crops is considerably more vulnerable to erosion than land protected by a cover of sugarcane. The Mauritius of the future must realise that it cannot attain maximum production without strict measures for controlling erosion.

v) *Intensity of Cropping* — Small farmers generally make the maximum use of the area available to them for cultivation. They even tend to overdo this by undue crowding with the result of lower yields. Increased production by small planters, however, is possible through the use of improved cultivation techniques, including among others the rational use of fertilizers and the routine control of pests and diseases.

vi) *Land Tenure* — Security of tenure is also important in attaining improved cultivation of foodcrops. A farmer is loath to apply adequate fertilizers if he feels that his tenancy does not offer sufficiently long security. Apart from Crown Land leases in the Government Settlement and Allotment schemes, most of the land leased for the cultivation of crops other than sugarcane is leased on a year to year basis and in any case for a period not extending beyond 2 to 3 years. Under such conditions there is no incentive to effect permanent improvements such as anti-erosion measures, effective drainage, etc. The ultimate result is a decline in production.

Under Mauritius conditions the classes of food crops which are most likely to succeed are the following :—

i) Vegetables of all kinds ;
ii) Pulse crops ;
iii) Potato ;
iv) Maize.

Before these crops are briefly discussed, it may be necessary to state the reasons why all Mauritian farmers give priority to sugarcane. These are :

i) Sugar is easily cultivated and probably poses fewer problems to the cultivator than many other crops,

ii) As compared with food crops and vegetables, the pest and disease hazards are more easily amenable to control under existing conditions of organization.

iii) The sugar crop is totally disposed of at known conditions of charges and prices. The industry is fully and well organized.

iv) There is with cane greater security of tenure, through the fact that Mauritius grows it on the long ratooning system.

v) Sugar offers greater resistance to both cyclones and droughts, and is moreover insured against such effects through the Cyclone and Drought Insurance Scheme.

vi) In view of the natural greater security of cane, the cane grower commands greater borrowing power from banks, co-operative Societies and middlemen.

vii) Sugar gives a more stable return on an acre basis.

viii) The cost of production of cane over several ratoons is less than that of crops like potatoes and most vegetables, and requires proportionately fewer men-days per acre.

Vegetables

Acclimatized vegetables of all kinds grow to perfection in Mauritius especially in regions of medium altitudes where rainfall is generally adequate and fairly well distributed. The demand for such crops exceeds the supply and this has been so for so long that prices of vegetables are usually good and the returns to the cultivator satisfactory. In more recent years, through the operation of the Commonwealth Sugar Agreement, the International Sugar Agreement, the working of schemes like the Cane Cyclone and Drought Insurance Scheme and the Sugar Industry Rehabilitation Fund, the tendency has been to grow more cane to the detriment of other crops, including the protective crops. Moreover, the growth of population, has resulted in some of the best vegetable lands being utilized for extending villages. While the island as a whole can grow most vegetable crops satisfactorily, it must be realised that certain localities are naturally better adapted to such production. In consequence, it would be opportune that the reserve of such lands, under a proper system of rotation, be established, so that the needs of the population in vegetables are met at reasonable prices.

In connection with the production of vegetables, it may here be pointed out that the Department of Agriculture has for the last 16 years developed a Seed Production Scheme of immense value to market gardeners. This scheme involves acclimatization and selection both for yield and resistance to diseases. This work has been of great value to Mauritius and the quantity of seeds of all sorts sold annually goes on increasing. Thus, Mauritius already possesses most

of the elements required for market gardening to become a permanent industry for the mutual advantage of both the growers and the consumers.

Pulse crops

From time to time the island suffers acutely from lack of protein foods. This was most acutely felt during the war years and those immediately following the war. The shortage of pulses was particularly hardly felt by that section of the population which does not consume meat or flesh of any kind. Of the pulses, the following grow very well here : beans, peas, pigeon peas. In regard to pigeon pea, work has proceeded at the Department of Agriculture over the last few years on the control of the numerous insect pests which attack this most valuable plant. This work has now proceeded to a point when results begin to show and it is gratifying to note that although there is still much work to be done, the results to date are quite encouraging.

It is not suggested that Mauritius should go in for crops, like lentils, which although they can be grown here, cannot be produced at a sufficiently low cost to compete successfully with the imported articles in normal conditions. In regard to the pulses which Mauritius is best adapted to produce, it is worth noting that beans and peas can easily be grown as inter-row crops with sugarcane, whilst the pigeon pea makes valuable hedges and windbreaks in vegetable gardens, providing also an appreciable source of humus.

Potato

Potato is the crop *par excellence* for the supply — apart from rice and flour — of the starchy requirements of the Mauritian diet. It grows satisfactorily in numerous localities either with or without watering. It can be grown to perfection in the inter-rows of young canes. Its vegetative cycle here is short enough to enable satisfactory yields to be obtained in rotation with sugarcane On lands entirely devoted to the crop two crops are taken in the year. Moreover, there seems to be no reason why potatoes should not be consumed in greater amounts by every section of the community. This crop has the further great advantage that it is raised outside the cyclone season and, when proper attention is paid to quality of seed, proper fertilization and control of diseases, it can give very satisfactory yields and profitable returns.

The main obstacle so far in regard to the development of potato production has been difficulties of seed supply and conservation. The supply of seed potatoes is unsatisfactory both in regard to quality and to the quantity available at any time during the planting season. It also often happens that seed of the variety it is desired to grow is not available at the right time because of shipping difficulties. The supply of even mediocre quality seed is continuously deficient. Furthermore, in view of the above, the price is usually unduly inflated. Better quality seed, free from seed borne diseases, would reduce to a large extent the principal hazard to which the Mauritian potato grower is now exposed.

There seems to be no reason why Mauritius could not produce its own annual seed supply raised from disease free stock renewable from time to time from abroad and tested under local conditions. For this, a proper potato seed production farm could be required combined with adequate cold storage of the seed produced.

Should the industry ever orientate along such lines, it will be necessary to control the marketing of this crop. In view of its nature this should not be difficult because even without cold storage, potato keeps very well locally for 3 months before germinating and could no doubt be kept even a little longer if necessary for consumption without serious deterioration. There would appear to be no reason at first sight for the cost of such stored seed to be greater than that of the best imported seed.

Maize

Mauritians are not maize eaters. There should, however, be considerable scope for extending maize production for the development of poultry. Poultry could be developed within a relatively short time to replace a sizeable proportion of the meat requirements of Mauritius, now mostly imported. Maize combined with beans and possibly with up to 10% of dried acacia (*Leucaena glauca*) meal and adjunction of animal protein, would provide broadly speaking adequate rations, almost entirely produced locally, for a developed poultry industry. In this context, maize, although perhaps the most vulnerable of all cereal crops to cyclonic winds, could occupy a far more important position in the agricultural economy of Mauritius. It can be taken as an interrow crop between can rows and of course in rotation with cane between the harvesting of one cane crop and the planting of the next. As regards the cyclone hazard it is well to remember the old Mauritian adage: "*Maïs planté en février, maïs en grenier*".

It is not proposed in this paper to consider all the food crops consumed on a small scale in Mauritius, like arouilles, manioc, sweet potato which are generally consumed more as vegetable supplements than as staple foods. It may be noted, however, that there might be scope for greater sweet potato production in connection with a pig breeding industry. This also applies no doubt to a crop like the Jerusalem artichoke which, together with the sweet potato, could possibly be experimented with for folding pigs.

Land Settlement and Allotment Schemes

It is apposite perhaps to conclude this paper with a note on the Government's more recent efforts to encourage food crop production. To this end and also to provide occupation on the land for the growing population, a Land Settlement Scheme was initiated in 1953. This started modestly with a portion of land of about 60 arpents; it now covers nearly 1,000 arpents, distributed as follows:—

i)	Richelieu	: 54	arpents	
ii)	Terre Rouge	: 260	,,	
iii)	Palmar	: 350	,,	
iv)	Petit Sable	: 98	,,	
v)	The Vale	: 16	,,	
vi)	Plaisance	: 125	,,	(in process of development)
vii)	Bée Manique	: 76	,,	(do)
	Total	979	,,	

In principle, with a view to maintaining fertility and ensuring a safe cash return, 50% of the acreage of all individual plots must be planted to food crops, inclusive of vegetables, the remainder being planted to sugarcane. No compulsion is of course made to plant cane.

FRUIT FLIES (TRYPETIDAE) OF ECONOMIC IMPORTANCE IN MAURITIUS

by

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Introduction

The first record of a fruit fly in Mauritius is by Latreille who, in 1817, stated that Catoire reported a heavy infestation of a Trypetid* fly on Citrus fruits. No specific determination of the insect was given but most probably it was the indigenous fly *Ceratitis catoiri* Guer.

In 1901, Coquiellett described another species of fruit fly from the island : *Dacus sigmoides* Coq., later renamed D. *ciliatus* Lw.

In 1942, six trypetids of economic importance were recorded while as a result of a survey over the last three years, two new additions have been made.

The following is an up-to-date list of the species recorded : *Dacus* (Strumeta) *zonatus* Saund, *D. cucurbitae* Coq., *D. ciliatus* Lw., *D. emmerezi* Bezzi, *Ceratitis capitata*, Weid., *C. catoiri* Guer., *C. rosa* Karsch, and *Pardalaspis cyanescens* Bezzi. The last two being new introductions dating most probably from 1953 for the former and 1958 for the latter.

This paper gives an account of the biology and present status of the various local fruit flies of economic importance in Mauritius together with descriptive notes which will enable identification of the various species.

Distribution of Species in Relation to Host Plants

Ceratitis capitata Weid. — The Mediterranean fruit fly.

This cosmopolitan species, recorded attacking a wide range of fruits and vegetables amounting to over 200 species in other countries, has a very limited number of hosts in Mauritius. Eight to ten years ago, the main fruits attacked in the island were peach, loquat, guava and chillies. Since 1955, this species has apparently been displaced by the newly introduced Natal fruit fly (*C. rosa* Karsch) and is now sometimes found in ripe chillies and more rarely in guava, peach and in *Carissa carandas* L. (locally known as corinda).

A similar state of affairs occurred in New South Wales (Mc Carthy, in litt.) when by the year 1948 *C. capitata* was displaced by *Strumeta tryoni*. According to Dr. Thistle**, *C. capitata* has just been driven out by *D. dorsalis* at the lower elevations in Hawaii. It is interesting to note that in the last-mentioned country the following wild and cultivated host fruits harbour *C. capitata* larvae : *Terminalia catappa* L. (Indian almond, Badamier), *Mangifera indica* L. (Mango), *Coffea arabica* L. (Coffee), *Psidium cattleianum* Sabine (Strawberry guava, Goyave de Chine), *Eugenia jambos* L. (Rose apple), *Achras sapota* L. (Sapodilla), *Averrhoa carambola* L. (Carambole). In Mauritius the results of a recent extensive survey showed that none of these fruits was infested

* To avoid confusion, the well-known name *Trypetidae* oew, 1862 is retained in lieu of *Tephritidae* (Newman 1845) Macquart 1835, as used by some recent authors. The name *Dacus* is also retained in place of *Strumeta* Classification of these and allied genera is in need of revision.

** Letter to Director of Agriculture dated 10th September, 1958.

by this insect, in spite of the abundance of strawberry guava and rose apple in the country.

(b) *Ceratitis rosa* Karsch — The Natal fruit fly.

This species is at present one of the most serious pests of cultivated fruits, especially loquat, peach, guava, mango, avocado, bullock's beart. For the past two or three years infestation has been so heavy that fruit production has become exceedingly difficult if not impossible : peach, loquat and bullock's heart being 100% attacked. It is believed that this fly was accidentally imported from South Africa by passengers carrying fruits in Mauritius and that it gained entry in spite of rigorous phyto- sanitary control at ports of entry. The absence of cyclones during the years 1945-1957 probably created ideal conditions for the species to build up enormously large populations. As with *C. capitata*, no attack was noticed on the strawberry guava. Negative results were obtained with *Solanum auriculatum* Ait. (the bug-tree, tabac marron) which in South Africa is a recognized host of *C. rosa* in early spring where it enables a first generation to develop before the cultivated fruits begin to ripen (Ripley & Hepburn 1930).

Table I, which has been prepared from the results of field observations and laboratory breedings, shows the host cycle of *C. rosa* throughout the year.

(c) *Ceratitis catoiri* Guer.

Only known from Mauritius and Réunion and according to Munro incorrectly recorded from Seychelles, this insect is common on a number of wild and cultivated fruits. It is not considered to be a serious pest, being apparently kept under control by *Opius* sp. nr. *insignipennis* Granger, the only parasite known so far in the island. It is often found jointly with *C. capitata* on guava, indian almond, jamalac.

(d) *Cucurbitaceous flies.*

The species attacking mainly cucurbitaceous plants are the following : *Dacus ciliatus* Lw., *D. emmerezi* Bezzi, *D. cucurbitae* Coq., *D. zonatus* Sound. Apart from *D. emmerezi* which is indigenous the three other species were accidentally introduced at periods which cannot be exactly specified. *D. cucurbitae* has occasionally been found attacking mango but never on tomatoes, string beans, cow peas, peaches, papaw or in tender stems, tap-root and leaf stalks of water-melon as reported in Hawaii (1953 — Ebeling-Nishida & Bess ; 1914 — Back et al). *D. zonatus* Saund was recorded 10 to 15 years ago on *Terminalia catappa* L., but is nowadays being displaced by *C. rosa* in this host. No other wild hosts of these various species have so far been recorded during the recent survey.

Seasonal activity : Attacks of the various species of Dacinae are very erratic. There is no well marked seasonal distribution of the different species.

TABLE I

HOSTS	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	REMARKS
Peach (*Prunus persica* Stockes)	X	X							X	X	X	X	100% fruits attacked
Mango (*Mangifera indica* L.)	X	X	X	X						X	X	X	Attacks less severe than for peach
Guava (*Psidium guajava* L.)		X	X	X	X	X	X		X	X	X	X	% attacked sometimes very low
Bullock's heart (*Anona reticula* L.)									X	X	X	X	100% fruits attacked.
Loquat (*Eriobotrya japonica* Lindl.)				X	X	X	X	X	X				100% fruits attacked.
Indian almond (*Terminalia catappa* L.)		X	X	X	X	X	X	X	X	X	X		10% fruits attacked.
Sapodilla (*Achras sapota* L.)	X	X									X	X	In this fruit larvae are of bright yellow colour and attacks are very severe.
Pineapple guava (*Fiijoa sellowiana*)				X	X	X							Attacks sometimes severe
Jamalac (*Eugenia aquea* Burm.)	X	X	X								X	X	60—90% fruits attacked.
Avocado (*Persea americana* Mill.)	X	X	X	X	X	X							In Avocado larvae thrive only in ripe fruits, immature fruits react to attack, the hard pericarp being most probably a limiting factor.
Jujube (*Ziziphus jujuba* Lamb.)						X	X	X					Attacks sometimes severe.
Rose apple, Jamrose (*Eugenia jambos* L.)	X	X	X								X	X	30—50% fruits attacked.

TABLE II

HOST PLANTS	Ceratitis capitata	C. rosa	C. catoiri	Pardalaspis cyanescens
Avocado pear (*Persea americana* Mills)	+0	+	+	—
Batoko plum or Prunier malgache (*Flacourtia ramontchi* L'Her.)	—	—	+?	—
Bottle gourd or Calebasse (*Lagenaria vulgaris* Serv.)	—	—	—	—
Bug tree or Tabac marron (*Solanum auriculatum* Ait.)	—	0	—	—
Bullock's heart (*Anona reticula* L.)	0	—	—	—
Carambola (*Averrhoa carambola* L.)	0	—	+	—
Coffee (*Coffea arabica* L.)	0	—	—	—
Cucumber (*Cucumis sativus* L.)	—	—	—	—
Custard apple or Atte (*Anona squamosa* L.)	0?	—0	+	—
Egg plant or Aubergine (*Solanum melongena* L.)	—	—	—	—
Grape fruit or Pamplemousse (*Citrus maxima* Muir)	—	—	+?	—
Guava (*Psidium guajava* L.)	0+	+0	+	—
Indian Almond or Badamier (*Terminalia catappa* L.)	0	+	+	—
Jamalac (*Eugenia aquea* Burm.)	0	+	+	—
Jambolan plum or Jamblong (*Eugenia jambolona* Lam.)	0?	—	+?	—
Jujube (*Ziziphus jujuba* Lam.)	+	+	+	—
Loquat or bibasse (*Eriobotrya japonica* Lind.)	—0	+0	+	—
Mango (*Mangifera indica* L.)	0	+0	+	—
Melon (*Cucumis melo* L.)	—	—	—	—
Otaheite-apple or Fruit de cythère (*Spondias cytheria* Cam.)	0?	—	+?	—
Papaw (*Carica papaya* L.)	0	+0	+ (occasionally in very over-ripe fruits)	—
Peach (*Prunus persica* Stokes)	0+	+	+	—
Pineapple (*Ananas comosus* L.)	0	—	—	—
Pineapple guava (*Fiijoa sellowiana* Berg)	—	—	—	—
Pomegranate (*Punica granatum* L.)	0	—	+	—
Prickly pear (*Opuntia tuna* Mill.)	0	0?	—	—
Pumpkin (*Cucurbita maxima* Duchesne)	—	—	—	—
Rose apple (*Eugenia jambos* L.)	—	—	—+	—
Sapodilla (*Achras sapota* L.)	0	+	+?	—
Snake gourd (Patole) (*Trichosanthes anguina* L.)	—	—	—	—
Squash or Patisson (*Cucurbita pepo* L.)	—	—	—	—
Strawberry guava or Goyave de Chine (*Psidium cattleianum* Sabine)	0	—	+ (Acc. to Mamet)	—
Surinam cherry or Roussaille (*Eugenia uniflora* L.)	0	—	+?	—
Tangerine or Mandarin Orange (*Citrus nobilis deliciosa* Saringe)	0	—	+	—
Tomato (*Lycopersicum esculentum* L.)	0	—	+	+

One infested cucurbit fruit can harbour several species of Dacus at the same time.

In upland country infestation slows down considerably in wintertime (June-August) ; in the lowlands, flies are active all the year round and generations overlap. Table II recapitulates the hosts of the various species of trypetid flies in Mauritius and other countries.

III Biology

(a) *Ceratitis spp.*

The biology of *C. capitata* being well known and having been adequately described by several authors, it is therefore considered unnecessary to deal with this species here.

C. rosa lays its eggs in batches varying from 10 to 20 within the tissue of the fruit. The female fly punctures the fruit and deposits eggs just below the skin sometimes piercing the fruit several times before laying. Fungi and bacteria subsequently gain entry inside the fruit and cause a rot. The percentage of fruits thus damaged is at times as high as 65% .

The number of punctures per fruit varies considerably ranging from 10 to 15 in peach, 8 to 15 in loquat and as many as 20 in guava. The number of fully developed eggs in the ovary of one female after dissection was found to be 25 and the average after dissection of 6 females was found to be 19. The eggs are whitish, elongate with a flat surface on one side and about 1.2 mm in length (cf 0.945 mm in *C. capitata*). The egg stage lasts 3 to 5 days at 25-28 °C and may be as much as 8 days in winter in the field (18-20°C). On unripe avocado pears, larvae often fail to develop but the puncture causes the development of a corky scar which diminishes the market value of the fruit. In most other fruits the young larvae burrow in all directions and develop rapidly. They are generally creamy white. The maximum number of larvae per fruit was: in loquat 24, in guava 31, in peach 18, and on a total of 100 loquat fruits 412 larvae were counted. The number laid in *C. capitata* may be not less than 350 per female. The prothoracic and caudal spiracles are as shown in Plate 1, figs. 1 a & 1 b.

There is a quiescent stage lasting about 12 hours between instars. The prepupal period is 1 to 2 days. Pupation as with other species occurs in the soil. The pupal period lasts about a fortnight in the laboratory but may be more than 17 days in winter in the field. Adults are generally active in the morning (about 9 o'clock), scarcer during the warmer part of the day and active again from 3 p.m. onwards. The preoviposition period varies also with temperature. It was found in laboratory to be as much as 15-20 days at 25-28°C and on the average 7 days. Copulation occurs 4 - 5 days after emergence ; its duration was not recorded. Oviposition has been observed to last 5 to 10 minutes. Under insectarium conditions, life of the adult fly, when fed on raisins and hydrolysed yeast and given plenty of water, was on the average 56 days at 27°C. (The

maximum recorded was 103 days). The adult can live up to 5 days without food at 25-28°C. Sexes occur roughly in equal proportions

Table III — *Life History of C. rosa at temperature 25-28°* C

	Days	Average	Remarks
Egg stage ...	3-5	4 days	In July eggs took 8 days to hatch on one occasion.
1st stage larva ..	3-4		
2nd stage larva ..	3-4	10.5 dys	Quiescent stage between instars : 12 hrs.
3rd stage larva ..	3-4		
Prepupa ...	1-2	1,5 dys	
Pupa .	10-13	11.5 dys	In July pupal period has been found to extend over 20 days.
TOTAL ...	23-32	27 days	

Table III above recapitulates the life history of *C. rosa*. It follows that a generation of flies takes about one month to develop during the winter months and about three weeks in summer. About 10 to 12 generations can be reckoned per year.

(b) *Pardalaspis cyanescens* Bezzi.

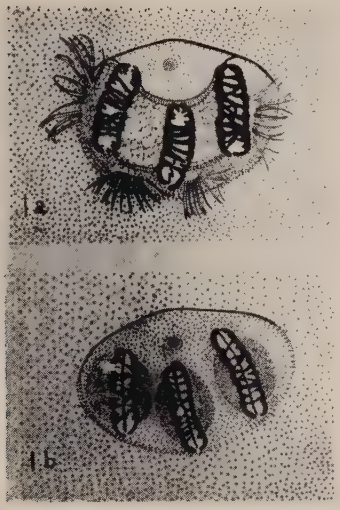
This fruit fly was described from Madagascar where it is probably indegenous*. It is found on many wild solanaceous plants as well as on cultivated tomatoes and is not reckoned in Madagascar as a major pest, being kept under control by various indigenous parasites and predators. A Braconid *Opius insignipennis* Granger, has been obtained from the pupae† in Madagascar and it is apparently this species which occurs in Mauritius (*V. et C. catoiri*). In 1951, in the island of Réunion, *Pardalaspis* was reported in some localities to infest 100% of the tomato fruits. As a result of insecticidal treatment, incidence of attack has recently been reduced to 10%.

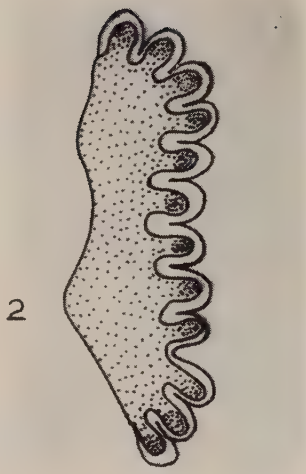
The first outbreak in Mauritius was recorded in October, 1958, in the lowland area round Port Louis. Fruit infestation was very severe and losses of 100% occurred in a number of fields. The insect is at present extending its range from lowland to upland country.

Biology : Adult flies are active throughout the day, but more so in the morning and afternoon, when they are found in numbers copulating and ovipositing on tomato plants. Copulation takes place 2-4 days after emergence of

* Bezzi 1923 Bull. Ent. Res. *15* : 102-105.

† R. Paulian — Letter dated 29.1.59.





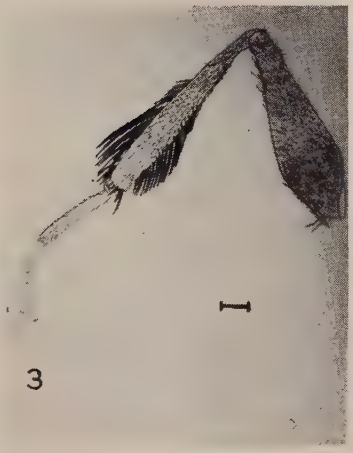


Plate I

Fig. 1 a — Caudal spiracle of *Ceratitis capitata* Weid.
1 b — Caudal spiracle of *Ceratitis rosa* Karsch.
2 — Prothoracic spiracle of *C. rosa* Karsch.
3 — Middle leg of *C. rosa* Karsch (♂)
4 — Cephalic seta of *C. capitata* Weid. (♂)

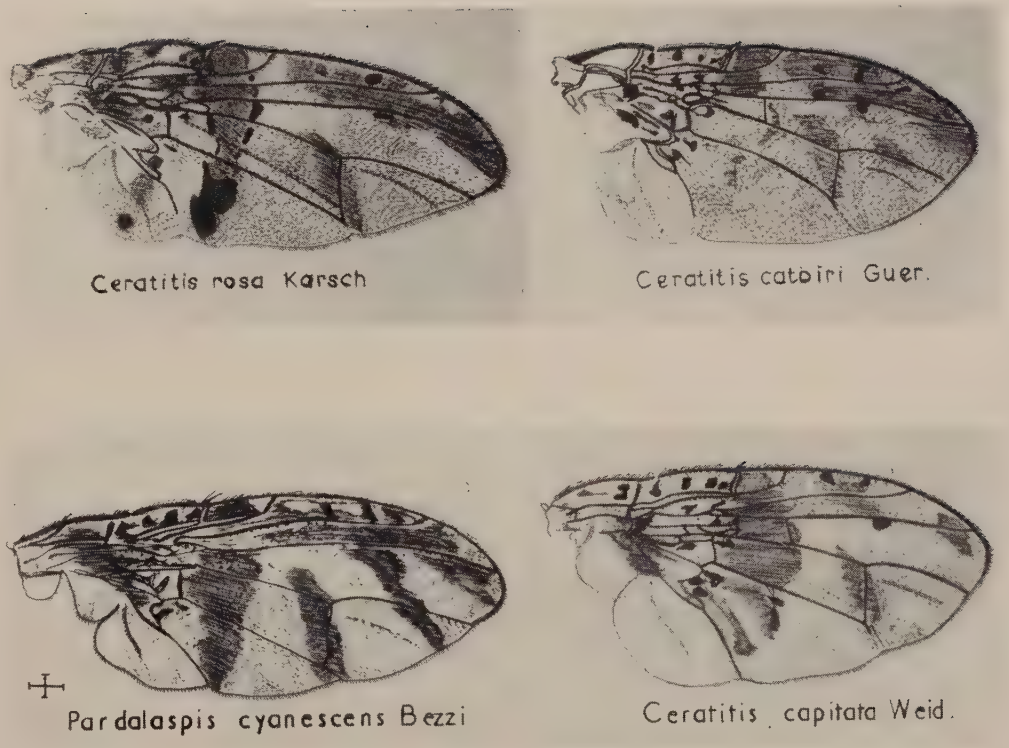


Plate II

Wings of *Ceratitis* spp. and of *Pardalaspis cyanescens* Bezzi

adults ; it has been observed under laboratory conditions to last about 4 hours. The preoviposition period may be from 4 to 6 days and the number of eggs laid varies from forty to a hundred or more. Tomato fruits of all sizes are attacked ; the number of punctures per fruit varies from 2 to 12 and the number of eggs per puncture from 2 to 15. Some punctures, however, are without eggs. Eggs are whitish in colour and measure about 1.05 mm. in length. At 29°C the egg stage lasts 3 days. The larvae on hatching penetrate deeper into the fruit which soon becomes dark and flaccid ; the full-grown larvae is 7-8 mm. long and is whitish to creamy white in colour. The larval stage in the fruit is from 10-15 days ; the number of full-grown larvae per fruit varies from 2 to 10. The larvae at maturity leave the fruit to pupate in the soil at a depth of 2 to 4 inches. The pupae average 5.2 mm in length. The length of the pupal period is about 10 days. The total life-cycle from egg to adult is 22 to 32 days. In the laboratory adult life varies from a few days to several weeks when kept at 27-29°C and fed on dried raisins. The sex ratio is nearly 1 : 1.

No wild host of Pardalaspis has so far been recorded in Mauritius. In Madagascar the main secondary host is *S. auriculatum* Act. (vern. tabac marron), a plant of wide distribution in Mauritius. Other solanaceous plants, e.g. *Solanum nigrum* L. (brède martin), *S. indicum* (anghive) are reported as hosts in Réunion Island. Details of wing are given in Plate II.

(c) *Dacus spp.*

Table IV summarises the life cycle of *Dacus ciliatus* and *Dacus emmerezi* in Mauritius during summer and winter months and also that of *D. cucurbitae* under laboratory conditions.

TABLE IV

	WINTER (JULY — AUGUST) Duration		SUMMER (NOV. — DEC.) Duration		
	D. ciliatus	*D. emmerezi*	*D. ciliatus*	*D. emmerezi*	*Dacus cucurbitae*
Incubation	4-5 days	3-4 days	2-3 days	2-3 days	1-4 days
Larval stage	15-17 „	15-18 „	4-6 „	5-6 „	4-9 „
Pupal stage	14-17 „	16-18 „	7-9 „	8-11 „	7-11 „
TOTAL	33-39 „	34-40 „	13-18 „	15-20 „	12-24 „
Mean Temp.	18°C		23°C		—
Lab. Temp.	—		—		30°C

Dacus ciliatus and *D emmerezi* go through at least three generations *every* 2 months and their life cycles are nearly similar. The number of eggs laid per puncture varies from 4 to 12 in *D. ciliatus*. In young pumpkin fruits a

mean of 8 eggs per puncture and about 10 to 36 larvae per fruit was observed. Seventy-seven eggs were counted in one puncture of *D. emmerezi*, suggesting that several females may lay eggs in or around the same puncture. The eggs of *D. emmerezi* average 1.57 mm x 0.34 mm. The number of eggs laid per female may vary from 20 to 300 or more. In *D. emmerezi* 65 eggs were found in one mature female. The average longevity of adults of *D. ciliatus* and *D. emmerezi* when fed on 5% sugar solution was 85 days.

IV — Identification of Species

The various species of Trypetidae occurring in Mauritius can easily be identified and distinguishing characters for *Pardalaspis* and the various species of *Ceratitis* are given in Plates I and II. Wing characters for Dacus spp. are not shown here as these have been fully described by Bezzi, Munro, Hardy and others.

Table V on opposite page is intended for farmers and growers who wish to identify fruitflies rapidly with the help of a hand lens. Female specimens of *Pardalaspis* and of *Ceratitis* spp. cannot be easily identified, male characters being more clear cut these only are given below. Concerning *Dacus* spp. it must be pointed out that wing markings in both sexes are sufficient for a correct diagnosis of the species. *Dacus zonatus* Saund. being generally very scarce is not dealt with here.

Control measures

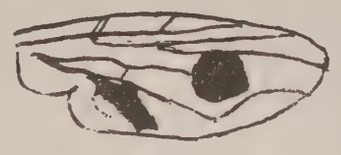
Chemical control : Insecticidal control measures which can be recommended in Mauritius vary with the different species of fruit flies and with the host plants. In general, however, insecticides such as Perthane, Rhothane, DDT, Malathion, Sodium silicofluoride, Dipterex, when used against *Ceratitis* spp. bring appreciable reduction in fruit infestation, the great factor which handicaps insecticidal control in Mauritius is the occurence of a relatively small number of orchards of appreciable size on one hand and the presence of fruit trees scattered throughout the island in small gardens on the other hand, which serve as potential foci of infestation. Regular systematic spraying cannot therefore be adequately carried out.

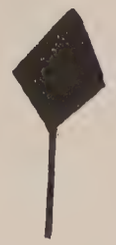
Isolated orchards and gardens may be however partially protected against *Ceratitis* spp. if early spraying with one of the above mentioned insecticides is carried out and regular weekly treatment made with baits such as a 10% sugar solution with 0.6% active ingredient of Dipterex or 0.3% sodium silicofluoride or 0.5% malathion. Infestation dropped from 100% to 30% in certain cases.

The various species of Dacus in Cucurbitaceous plantations are to a large extent controlled with bait sprays containing a 5% sugar solution and one of the following insecticides; lead arsenate (.15%) active ingredient, DDT, (0.02% a.i.) gammexane 0.3% or aldrin (0.1% a.i.)

The bait spray is applied preferably in the afternoon on foliage of maize

TABLE V

Ceratitis (Pterandus) rosa Karsch male	*Ceratitis catoiri* Guer. male	*C. capitata* Weid. male	*Pardalaspis cyanescens* Bezzi male	*Dacus emmerezi* Bezzi male & female	*D. ciliatus* Lw. male & female	*D. cucurbitae* Coq. male & female
Middle legs broadly feathered at least on the tibiae. (*Plate II fig 3*)	Legs uniform	Legs uniform	Legs uniform			
Cephalic setae absent	Cephalic setae white	Cephalic setae black (*Plate II, fig 4*)		Dark band across wings	Absence of spots on wings	Dark spot at angle of wings



N. B: In general *C. catoiri* is distinct from *C. capitata*, and of larger size.

TABLE VI

SPECIES	Country of Origin	1935		1939		1949		1957		1958		1959	
		No. sent	No. received alive	No. sent	No. received alive	No. sent	No. received alive	No. sent	No. received alive	No. sent	No. received alive	No. sent	No. received alive
Opius phaeostigma Wlksn	S. Africa	?	4	—	—	—	—	—	—	—	—	—	—
O. incisi Silv.	Hawaii	—	—	—	—	—	—	940	865	—	—	—	—
O. cophilus Silv.	,,	—	—	—	—	—	—	3637	2021	16075	11174	2530	975
O. tryoni	,,	—	—	—	—	—	—	14	5	—	—	—	—
O. formosanus Full.	,,	—	—	—	—	—	—	215	215	1100	635	1250	490
O. compensans Silv.	,,	—	—	—	—	—	—	230	224	800	84	850	600
O. longicaudatus Ashm.	,,	—	—	—	—	—	—	534	509	650	600	2000	1900
O. longicaudatus var. *taiensie* Full.	,,	—	—	—	—	—	—	300	265	1525	900	250	235
O. longicaudatus var. *novacaladonicus* Full.	,,	—	—	—	—	—	—	300	210	1700	990	250	240
O. longicaudatus (varieties) mixed	,,	—	—	—	—	—	—	1278	774	30520	18704	1860	1750
Dirhinus giffardii Silv.	,,	—	—	—	—	183	182	12200	11588	2150	977	—	—
Dirhinus auratus Ashum	Ceylon	—	—	1200	200	—	—	—	—	—	—	—	—
Spalangia sp.	,,	—	—	800	80	—	—	—	—	—	—	—	—
Syntomosphyrum indicum Silv.	Hawaii	—	—	—	—	—	—	16500	10125	41450	26115	59000	31400
Total		—	4	2000	280	183	182	36148	26801	95970	60179	67980	37590

Total insects imported during the years 1935, 1939, 1949 = 2,183
,, received alive ,, = 466
Total insects imported during the year 1957—1959 = 200,098
,, received alive ,, = 124,570

It is interesting to note that two of the various species recently introduced, namely, *Syntomosphyrum indicum* Silv. and *Opius oophilus* Silv. have been recovered on *Ceratitis* spp.

planted for the purpose in two rows 6 ft. apart at the periphery of fields. One advantage of border spraying is that poisonous residues are not left on the crop.

Experiments with the addition of hydrolysed yeast to sugar bait sprays were tried on a small scale with no conclusive results. Diluted molasses 10% was tried to replace hydrolysed yeast. This product was found to cause scalding of leaves and defoliation on rosaceous plants, namely peach and loquat. Soil treatment with aldrin or heptachlor to control emerging flies is a useful auxillary measure.

The tomato fly : *Pardalaspis cyanescens* is a recent introduction, treatment with various insecticides is in progress. In a newly infested tomato plantation Dipterex wettable powder 50% was tried and gave very promising results. This chemical used at the rate of 0.5% active ingredient in weekly sprays and a 10% sugar bait spray at 0.6% active ingredient reduced an 86% fruit infestation to 10% in one locality.

In Réunion DDT used at the rate of 0.3 — 0.35% active ingredient is regularly employed with success as a spray every 8 — 10 days (Plenet in litt.). When *Pardalaspis* develops resistance to DDT, Diazinon is added to it.

Biological Control :—

Only two local parasites of fruit flies are recorded in Mauritius namely *Eucoila* sp. (Cynipidae — Eucoilinae) on *C. capitata* and *Opius* sp. nr. *insignipennis* Granger found attacking *C. catoiri*. Paulian recorded the latter parasite on *Pardalaspis cyanescens* in Madagascar.

In Mauritius these parasites are scarce and only a few individuals of *O. insignipennis* were collected from thousands of infested fruits collected. Their beneficial effects are probably insignificant.

The ant *Pheidole megacephala* F. and the lizard *Calotes versicolor* are occasional predators of the various species of fruit flies.

In presence of the low incidence of the above mentioned local parasites, other insects to check fruit flies were introduced during the period 1935 — 1949 and mass introductions resumed in 1957. Table VI summarizes the position to date.

Summary

The various fruit flies of economic importance occurring in Mauritius are recorded. From 1817 to date seven species have gained access into the island. Only one species *Ceratitis catoiri* Guér. is indigenous to Mauritius and Réunion.

About 10 - 12 generations per year are reckoned for *Ceratitis rosa* Karsch and 15 - 18 generations for *Dacus ciliatus* Lw. and *D. emmerezi* Bezzi. The life cycle of *Pardalaspis* from egg to adult is about one month.

Secondary hosts of *Ceratitis* spp , although scarce, serve as continuous foci of infestation all the year round. Only four host plants of *C. capitata* are known in the island as compared to more than a score in other countries. It is interesting to note that *C. rosa* and *Pardalaspis cyanescens* Bezzi have never been recorded on *Solanum auriculatum* Ait. although this is the chief wild host in S. Africa and Madagascar respectively.

Over 15 parasites from various countries were introduced from 1935 - 1959 and a total of about 125,000 individuals were liberated.

Parasites recovered so far are *Syntomosphyrum indicum* Silv. and *Opius oophilus* Silv. Effects of indigenous parasites and predators are negligible.

Acknowledgements

The authors are indebted to Mr E. O Pearson, Director of the Commonwealth Institute of Entomology, for help in having specimens identified and in supplying valuable information. They extend their thanks to Dr. H. K. Munro of Pretoria for identifying collections of fruit flies submitted and to Dr. R. Paulian of the *Institut de Recherches Scientifiques* of Madagascar and Mr. A. Plenet of the *Services Agricoles de la Réunion* for supplying other useful data.

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THE YEARS OF REPUTED DROUGHT

by

A. D. SWAN, B. Sc.

The most authentic definition of the word « drought » is given in the International Meteorological Vocabulary of the World Meteorological Organisation Edition 1959, as follows :—

Drought — Temporary aridity due to absence or deficiency of precipitation.

Anybody who had a rough idea of what constitutes a drought has still a rough idea.

However that is not our problem. In Mauritius the problem as it affects the economy of the island is much simpler. Without endeavouring to be too precise, I think it can be said : « If a period of temporary aridity causes a marked fall in the amount of sugar produced then a drought may be said to have occurred ».

How and to what degree such a definition may be applied to the Crop Year of 1959 is a matter of conjecture. Without any doubt, an acute temporary aridity existed as from April 1959 and continued until practically the end of the Crop Year.

Nevertheless the crop was substantially a record so there was evidently no marked fall and the definition fails in this overall application.

There is clearly no point in accepting in Mauritius a definition of drought without reference to the sugar production. From the point of view of the economy of the island, a definition so based has no meaning. If the months of maturation are associated with a period of temporary aridity it is, in general, more likely to be to the benefit of the crop than otherwise, and conversely, a wet maturation period as occurred in 1952, may, on currently accepted figures, be as much of a disaster as a severe cyclone.

The application to the sugar production of the effects of temporary aridity therefore remains as a subject requiring study and research. What we can do is to arrive at an average figure based on the yields over the years of record of the proportionate yearly incidence of loss due to reputed drought conditions.

Of course, the figure reached is that based on prevailing practises of irrigation and fertilisation. There is no way of avoiding this. The actual value of a gallon of water at the cane field connot be computed

unless yields obtainable under optimum soil moisture conditions associated with optimum plant feeding conditions are known. Here we can deal only with the question of drought hazard in relation to the normally expected yield

The years of drought in the period 1877-1937 have been stated to be 1882, 1885, 1886, 1897, 1904, 1915, 1923, 1930 and 1934. Nine years in all and readers of my earlier papers will note that nearly all the years from 1877, have, in one place or another been referred to.

The only exception is the year 1917 and a minor digression might be made at this stage.

It will have been noted that attempts have been made to make it clearly borne in mind that the production of sugar is not a purely objective practice of the nature of a laboratory study. Many factors wholly outside the scope of the agricultural scientist have their influence on the years result. The purpose of the grower is not achieved until the crop has been sold and inordinately high production costs or an inordinately low market price affect the degree of profit to be made. Incentive to the grower ceases and production declines. For these reasons times of economic change and stress disrupt the picture of the advancement of the industry and only settled times permit the drawing of inferences of a direct relationship between growing factors and final yield.

A buyers world market is as big a disaster for the industry and for Mauritius as a severe cyclone or drought. As much has been said of the 1940 and as much may be said of 1917. Undoubtedly, possibly to a lesser degree similar causes have had similar effects in other years. These factors are not susceptible of statistical interpretation and computation.

Here then are the years of reputed drought with estimates of the losses involved :

Year	Assumed Normal* Yield 1,000 tons	Actual Yield 1,000 tons	Total Percentage deficiency	Percentage Deficiency due to*	Net deficiency due to drought
1882	132	124	6%	—	6%
1885	126	122	3%	—	3%
1886	125	106	15%	—	15%
1897	183	124	32%	—	32%
1904	213	213	0%	Cyclone 13%	0%
1915	268	215	20%	Cyclone 10%	10%
1928	253	202	20%	—	20%
1930	269	221	18%	Flood 5%	13%
1934	295	179	39%	Cyclone 14%	25%

* Statements of normals and estimates of damage are derived from La Revue Agricole 1950, 38 pp. 172 *et seq.*

The year 1904 in particular calls for comment. In some respects, it bears a close resemblance to 1959. In spite of a protracted dry period from April onward a record crop was attained. In addition, however, there was quite a considerable cyclone causing a loss of 13% (an estimate of 26% has been given), Like 1959, but for the accident of the cyclone and the abbreviated growing season a wonder year might well have been anticipated and not merely a year of record production.

The figure of 5% of the loss attributed to flood damage in 1930 is quite arbitrary. The floods, which actually occurred in the last days of 1929 caused a great deal of damage to roads, buildings and property. 39 inches of rainfall were recorded in two days at Flacq. The recent floods of 1959 bear a close parallel. The floods occurred, however, very early in the crop year and good rainfall in the following month may have permitted much of the damage caused to be repaired.

1897 shows the greatest drought loss In point of fact every month of the year 1897, except for minor excesses in June and September, had substantially less than the normal rainfall with a total deficiency for the year, of 45% . In addition, large deficiencies were recorded from September (and earlier) until December in 1896. Against this background of severely adverse conditions, it seems remarkable that as much as 70% of the normal crop was actually brought in.

The then Director of the Observatory, Mr. T.F. Claxton is moved in his Annual Report to make the following comment :

" The result of the prolonged drought has been an exceedingly poor sugar crop. "

1934 had a severe cyclone at the end of January, severe at least in terms of the records as considered prior to the cyclones " Alix " and " Carol " of 1960 The crop year was generally very dry from October 1933 to March 1934.

However, September and November of 1934 were exceptionally wet, November having 4 times the average rainfall and some of the loss attributed to the drought may have actually been caused by these adverse maturation and harvesting conditions

Taking the picture of the reputed drought years as a whole, it will be seen that totalling the losses for the nine years examined, a figure of 124% is reached over the years 1877 to 1937.

This is a net mean yearly loss due to the occasional droughts of 2% , at present prices about Rs. 7,500,000. Any year classified as a drought year shows a mean net loss of 14% .

Two points remain to be re-emphasised. First reference has been made only to the years of declared droughts. There will be many years

when partial drought conditions will have been contributory causes to small yields without these conditions being sufficiently marked or sufficiently severe to have merited the years being described as drought years. The figure of 2% will thus be an accordingly low estimate.

Secondly this figure relates only to the normally occuring element of hazard and bears no relationship at all to the promotion of production by skilled irrigation and its partner plant feeding. It is not practicable to envisage a water storage plan which would seek to prevent drought conditions such as prevailed in 1897 and 1934. On the other hand, improved irrigation facilities may do much to alleviate the effects of such conditions particularly if they are used in conjunction with a sound understanding of the varietal growth characteristics. Such facilities would automatically improve yields even in normal good years.

REVUE DES PUBLICATIONS TECHNIQUES

GUNN, J. R. — **Automatic Cane Carriers.** (Chaînes à Cannes Automatiques). Proc. 32nd Cong SASTA 1958, 68-71.

Il est généralement reconnu que l'alimentation uniforme de la première unité d'un train de moulins est d'une grande importance. Le chargement de la chaîne à cannes étant le plus souvent variable, il est nécessaire pour obtenir cet alimentation uniforme de faire varier la vitesse de la chaîne. Un système de contrôle automatique de cette chaîne doit non seulement empêcher que la chute du crusher ou du 1er moulin ne soit ni trop remplie ni trop vide, mais il doit aussi ralentir la chaîne à cannes lorsque l'effort demandé aux coupe-cannes devient trop élevé.

L'auteur décrit deux systèmes de contrôle employés en 1957 sur chacun des deux tandems de la sucrerie Maidstone. Le plus gros de ces tandems est alimenté par une chaîne entraînée par un moteur à vapeur; ce moteur est contrôlé au moyen de deux vannes de dimensions différentes installées en parallèle. L'on peut ralentir la chaîne en fermant la plus grande de ces deux vannes tandis qu'on l'arrête complètement en fermant aussi la seconde vanne. Les deux vannes sont contrôlées au moyen d'un solénoïde. Lorsque la surcharge des moteurs des coupes-cannes atteint un certain niveau, des relais actionnent ces solénoïdes et ralentissent tout d'abord la chaîne, puis l'arrêtent complètement si la surcharge continue à augmenter. La surcharge passée, les vannes se rouvrent et les conditions redeviennent normales. De cette façon la chaîne est asservie à la charge des coupe-cannes. Pour empêcher toutefois que la chute du crusher ou du 1er moulin ne déborde, il y a dans cette chute un bras qui est soulevé à mesure qu'augmente le niveau des cannes dans la chute. Si ce niveau atteint une certaine hauteur, un relai est actionné par ce bras et ralentit la chaîne tandis que si le niveau monte encore plus haut, la chaîne est alors complètement arrêtée par un second relai, jusqu'à ce que le niveau diminue. Ainsi donc la chaîne s'arrête automatiquement en cas d'engorgement de la première unité du tandem.

L'autre tandem est alimenté par une chaîne entrainée par un moteur électrique au moyen d'un accouplement magnétique. Cet accouplement est contrôlé par la charge des moteurs des coupe-cannes et le niveau des cannes dans la chute. Tout comme dans le premier cas le système fonctionne automatiquement.

Pour conclure l'auteur énumère quelques avantages qu'offre le contrôle automatique de la chaîne à cannes :

a) Il n'y a point de surcharge ni d'arrêt des moteurs de coupe-cannes.

b) L'alimentation du crusher est régulière.

c) Le contrôle peut être fait à distance.

d) Le contrôle est plus sûr que le contrôle manuel car il n'est pas sujet à la fatigue humaine.

e) Il permet de réaliser une économie de main d'œuvre.

HARDY, R. — **Automation in the Sugar Industry** (L'automation dans l'Industrie Sucrière) Proc. 32nd Cong. SASTA 1958, 72-77.

Après une introduction dans laquelle l'auteur parle d'une façon générale de l'instrumentation et des avantages qu'elle apporte à notre époque, l'auteur donne deux exemples de contrôle automatique qui a été employé dans l'industrie sucrière. Il s'agît tout d'abord du contrôle automatique du vide dans les appareils à cuire, qui devait être incessamment mis en pratique à la raffinerie de Hulett à Rossburgh.

Durant les cuites, il est nécessaire d'avoir un contrôle très effectif du vide dans les appareils à cuire. Ce vide est mesuré par une colonne d'eau et le contrôleur de vide règle la quantité d'eau admise dans le condenseur tubulaire. Si le condenseur tubulaire n'est pas suffisant pour maintenir le vide désiré, alors l'eau est injectée automatiquement dans un autre condenseur à injection directe de façon à maintenir le vide. Ce système permet une économie de chaleur car la chaleur transmise à l'eau dans le condenseur tubulaire est en partie récupérable, tandis que celle transmise à l'eau dans le système directe ne l'est point.

Le deuxième exemple que décrit l'auteur est celui du contrôle de la densité du lait de chaux. Cet appareil consiste essentiellement en une portion de tuyau flexible par lequel passe le liquide. Ce tuyau est posé sur une balance pneumatique et son poids varie avec la densité du fluide qui le traverse. Les indications de cet instrument sont relayées à un contrôleur qui règle l'ouverture d'une vanne par laquelle est admise de l'eau, et la quantité d'eau admise par le contrôleur est toujours dans la proportion voulue pour que le lait de chaux ait la densité que l'on désire. Un contrôle précis dans un tel cas demande une lecture précise et rapide de l'appareil.

L'auteur conclut en disant que si l'on n'avait point suffisament tiré parti jusqu'à l'heure des avantages que l'instrumentation pouvait apporter à l'industrie cela était surtout dû au manque de techniciens dans ce domaine.

COMPERE, R. — **Etude toxicologique du Leucaena glauca chez les bovins** *Bull. Agric. Congo Belge*, 5, 1311-1320, 1959.

A la suite d'essais d'alimentation effectués aux Iles Hawaii avec

*Leucaena glauca**, des cas d'intoxication sont apparus sur le cheval, le mulet, l'âne, le porc, le lapin et le rat. Les symptômes caractéristiques observés sont une inhibition de croissance et une forte dépilation. L'ingestion prolongée de grandes quantités de *Leucaena glauca* provoque la mort des animaux autres que les ruminants. Le principe toxique responsable est la « Mimosine » ou « Leucaenine ». Les expérimentateurs hawaiiens ne signalent aucun symptome précis d'intoxication chez les ruminants et concluent que la mimosine est détruite dans le rumen. Les récents travaux de digestibilité sur moutons par Damseaux à Gembloux avec du matériel déshydraté originaire de Mulungu, font état d'une action à la fois toxique et épilante qui apparait après ingestion de 500 gr de *Leucaena* sec. A la suite de ces observations, il a été entrepris un essai d'affouragement exclusif de *Leucaena* sur un taurillon. Pendant l'expérience et jusqu'au 75e jour, *Leucaena glauca* a été distribué en vert à volonté à l'animal et a constitué sa seule nourriture.

Aucune période d'adaptation progressive à ce nouveau fourrage n'avait été prévue et le changement brusque de régime n'a provoqué aucun trouble. Les déséquilibres minéraux les plus marqués ont été atténués par adjonction de 20 g de sel et 70 à 105 g de phosphate monosidique à la ration alimentaire journalière. Pendant les vingt premiers jours de l'expérience l'animal a consommé une moyenne de 12 kg de matière verte par jour et s'est développé au taux de 523 g par jour. Condition de l'animal très bonne. Du 21e au 49e jours on constate un état de santé excellent, l'animal consomme la dose relativement élevée de 32,8 kg par jour et fait une croissance de 1142 g par jour. Arrêtée au 49e jour, l'expérience confirmerait l'hypothèse de la destruction totale de la mimosine dans le rumen. Le 50e jour au 65e constitue la période de pré-intoxication. La consommation de la matière verte et l'appétence n'ont pas baissé mais le poids de l'animal reste stationnaire et les signes précurseurs de l'intoxication apparaissent : diminution de l'appétit à partir du 66e jour, dépilation localisée, acroissement des zones dépilées, plaies au bas des membres, irritation du fourreau. Au 75e jour l'animal se trouve dans un état désespéré, ne mange plus, état comateux, hypothermie, pouls irrégulier, respiration lente et profonde, bave abondante et yeux clos.

A partir du 75e jour l'animal est traité par des purgatifs énergiques, ingestion d'eau bicarbonatée et injections sous-cutanées de pilocarpine. Au 92e jour de l'expérience l'animal est complètement rétabli. A l'abattage on examine le foie et les reins qui ne présentent aucune altération pathologique grave résultant de l'empoisonnement par ingestion de toxique. Après cette expérience, eu égard aux effets toxiques décrits, on peut conclure que *Leucaena glauca* peut être considéré comme une des rares plantes fourragères tropicales ayant une aussi grande valeur énergétique à l'unité de matière verte et possédant une aussi forte teneur en protéines digestibles. Il est d'un grand intérêt pour l'alimentation du jeune bétail précoce

* Arbuste connu à Maurice sous le nom d' "Acacia" qui produit un excellent fourrage dans les régions côtières de l'Ile.

et des vaches laitières à haute production. Sous un volume réduit aisément consommable, il procure aux animaux une meilleure alimentation en protéines digestibles indispensables à la production laitière. Il reste à introduire et à sélectionner des variétés à faible teneur en principe toxique, à déterminer les proportions à ne pas dépasser dans le rationnement et le mode d'incorporation dans les rations et à estimer les possibilités alimentaires

PY, C. — **La lutte contre les mauvaises herbes en plantation d'ananas.** *Fruits d'Outre Mer,* 9, 369-385, 1959.

L'auteur résume ainsi son étude . l'application des herbicides à débit réduit a fait ses preuves et est maintenant largement pratiquée pour lutter contre les mauvaises herbes dans les plantations d'ananas. Que l'application soit faite par pulvérisation simple ou par atomisation à l'aide de pulvérisateurs pneumatiques, le résultat est à peu près le même. La pression d'un violent courant d'air dans le cas de l'application par atomisation rend cependant ce mode d'application plus dangereux pour la plante quand l'application a lieu peu après la plantation, mais la dispersion du produit présente au contraire un avantage quand les plants sont bien développés. On notera par ailleurs que le prix de revient de l'application par atomisation est nettement plus élevé et exige une main-d'œuvre plus qualifiée que l'application par pulvérisation simple.

ROCHE, P. ; VELLY, J. & JOLIET, B. — **Utilisation du diagnostic foliaire de l'arachide dans le secteur du Lac Alaotra.**

L'Agronomie Tropicale 2, 165-197, 1959.
Bull. Agric Congo Belge, 5, 1435, 1959

Des essais d'engrais sur arachide ont été poursuivis pendant 3 années dans la région du Lac Alaotra. Des analyses foliaires ont été faites et ont permis une meilleure interprétation du diagnostic foliaire sur cette plante. Pour les types de sols en culture, il est démontré que la nutrition minérale de l'arachide est satisfaisante lorsque les seuils suivants sont atteints : Azote-3,5% de la mat. sèche ; P- 0,2% ; K-2%. En représentation trilinéaire l'optimum est de N : 58 à 5% ; P : 3 à 5% & K : 32 à 40% . L'analyse foliaire appliquée à l'arachide permet de tester la fertilité du milieu avec autant de précision que l'analyse proprement dite des sols.

TARRAGON, H. DE — **Emploi de la potasse dans les cultures tropicales.** *Rev. Int. des Produits Tropicaux* Nos 346/347, 151-154, 1959.

Depuis 30 ans la consommation des engrais potassiques dans les pays à climat tempéré de l'hémisphère Nord a fait des progrès spectacu-

laires alors que jusqu'à la fin de la dernière guerre son emploi dans les pays tropicaux se développait beaucoup plus lentement. Ceci est dû à un ensemble de facteurs d'ordre économique, social et politique. La majeure partie des pays tropicaux à part ceux du Sud Asiatique disposent dans l'ensemble d'une grande surface agricole pour nourrir une population encore peu dense comme en Amérique du Sud, l'Afrique Centrale et l'Australie. Les techniciens de ces pays n'attachaient guère d'importance à la fumure chimique des cultures, facteur d'augmentation de rendements. Il s'y pratiquait une forme d'agriculture extensive où de nouvelles terres étaient mises en culture lorsque la fertilité des sols cultivés déclinait. L'orientation de l'agriculture tropicale vers une production intensive nécessite l'emploi des engrais chimiques et tout spécialement celui de la potasse en raison du fait que la grande majorité des plantes des pays chauds en sont de grosses consommatrices. Par exemple, au Japon pour la culture du riz la consommation annuelle de la potasse de 1923 à 1956 a quintuplée. L'Inde a aussi reconnu la nécessité d'augmenter les rendements de ses rizières par un emploi plus rationnel d'engrais chimiques complets. D'après des expériences faites dans ce pays un excédent moyen de 282 kg de grains par ha était obtenu à la suite d'une application de 50 kg de K_2O à l'ha, augmentation qui, ramenée à l'échelle des cultures de ce pays, représenterait 4.000.000 de tonnes de grains. De même, les cultivateurs de café et de canne à sucre s'intéressent de plus en plus à la fumure minérale et toutes les expériences qui sont faites démontrent le rôle important que la potasse est appelé à remplir dans la culture tropicale. L'emploi de cet engrais va certainement continuer à se généraliser et revêtira bientôt une importance aussi grande que pour les cultures des climats tempérés où il a sans aucun doute grandement contribué au relèvement spectaculaire des rendements.

TISSEAU, M-A. — **La déficience en cuivre et en zinc chez l'ananas : Le « Crook-Neck ».** *Fruits d'Outre Mer*. 9, 363-367, 1959.

Maladie de carence décrite par les auteurs du Queensland et de l'Afrique du Sud qui l'ont observée dans des terres pauvres. Elle s'est manifestée il y a quelques temps sur les jeunes plants d'ananas en Guinée. Les premiers symptomes apparaissent sur 4 ou 5 feuilles à quelques cm de la base comme des brûlures pouvant être occasionnées par les engrais. Les feuilles se sectionnent à l'endroit atteint et se dessèchent graduellement. Les plus âgées prennent une allure contournée et leur extremité se flétrit très rapidement. Le bouquet de feuilles plus jeunes que celles nécrosées réagit à la déficience en marquant un temps d'arrêt très net dans son développement puis se courbe et prend une orientation pratiquement parallèle au sol qui donne au plant une allure courbée et couchée caractéristique de ce déséquilibre. En outre, le feuillage révèle des taches jaunâtres translucides en nombre plus ou moins grand, symptomatiques de la carence en zinc. La répartition des plants atteints est très irrégulière sur le terrain. La déficience donne aux plants un aspect très caractéristique qui permet un diagnostic rapide. Le moyen de lutte est

simple mais doit être appliqué avec précaution : pulvériser sur le feuillage du sulfate de zinc et incorporer au sol du sulfate de cuivre. *Il ne faut jamais pulvériser le sulfate de cuivre sur le feuillage sous peine de causer de très grandes brûlures.* On doit commencer le traitement curatif dès l'apparition des premiers symptomes permettant un diagnostic sûr. S'il est bien appliqué les plants reprendront rapidement leur allure normale et tous les symptomes auront disparu au bout de 3 ou 4 mois. Il faut traiter tous les pieds dans le secteur où la déficience se manifeste, même les plants apparement sains peuvent souffrir de ce déséquilibre sans que leur aspect extérieur le fasse encore pressentir. L'application du traitement se fait par pulvérisation sur le feuillage d'une solution de sulfate de zinc à 1 %. Il faut environ 2,000 litres de liquide à l'ha soit 20 kg/ha de sulfate de zinc. Ce traitement peut être fait simultanément avec l'application de malathion contre la cochenille farineuse ou de dieldrine contre les fourmis véhiculant ces cochenilles. En cas de nécessité on peut répéter le traitement si le premier ne semble pas avoir eu d'effet. L'application du sulfate de cuivre se fait sur le sol près ou autour des plants au moyen d'une solution à 1,5-2 %. Il faut environ 40 ou 50 cms de solution par plant, soit environ 2 000 litres de solution équivalent à 30 ou 40 kg/ha de sulfate de cuivre. Comme moyen préventif lors de la replantation des parcelles carencées on peut mélanger 25 kg de sulfate de cuivre et autant de sulfate de zinc à l'engrais de fond qui sera épandu lors de la plantation.

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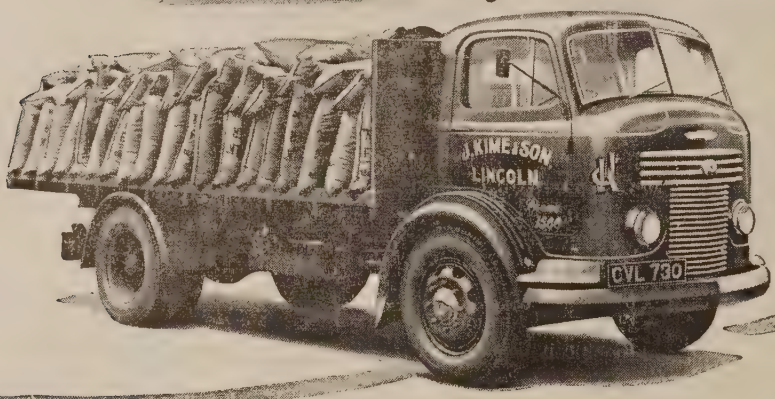

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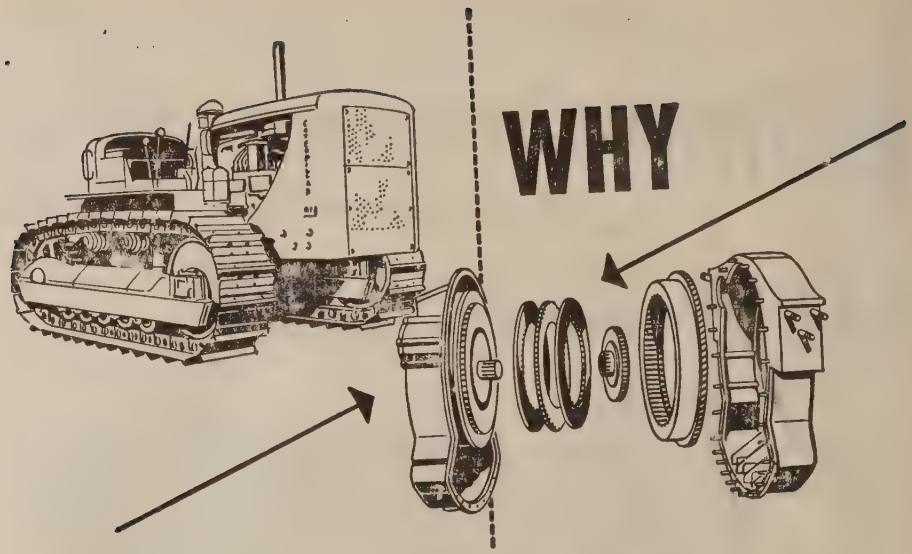

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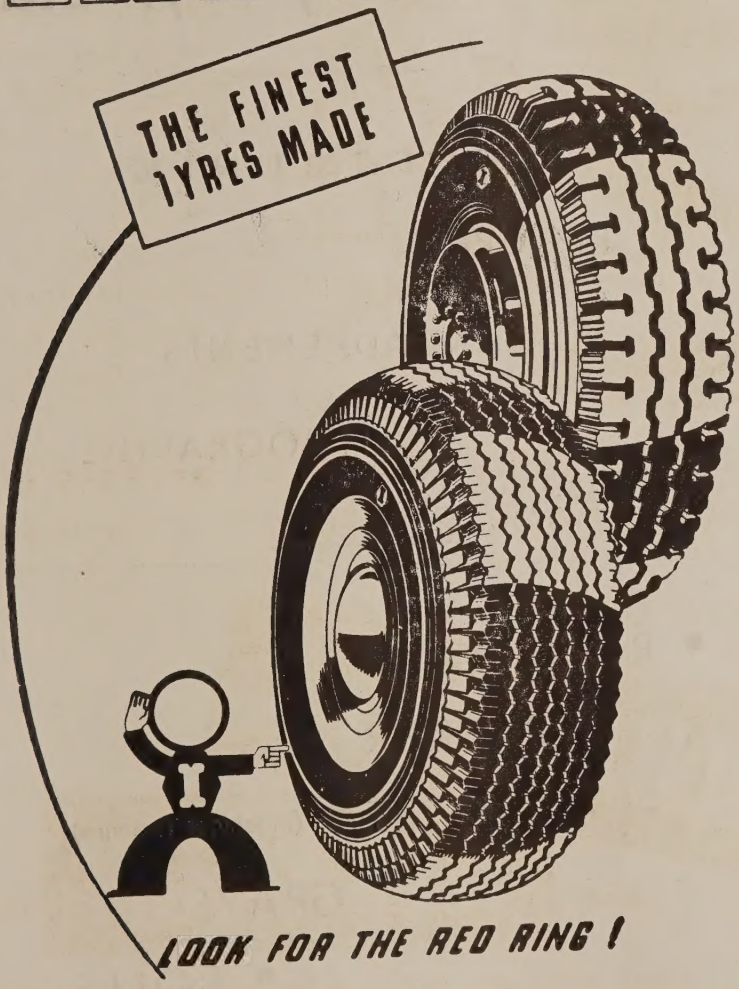

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